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A Record of the Progress of Pharmacy and the Allied Sciences

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Vol. 102 — FEBRUARY, 1930 — No. 2

CONTENTS

Editorials:

E Scintilla Lux 55

Education and Research 57

Original Articles:

The Quality of Commercial Ether. By Henry Leffmann and Charles C. Pines, Philadelphia 58

The Modern Sun Cult. By J. W. Sturmer, Philadelphia 63

Soil and Sod. By Arno Viehoever, Philadelphia 81

Correspondence 118

Medical and Pharmaceutical Notes 121

News Items and Personal Notes 127

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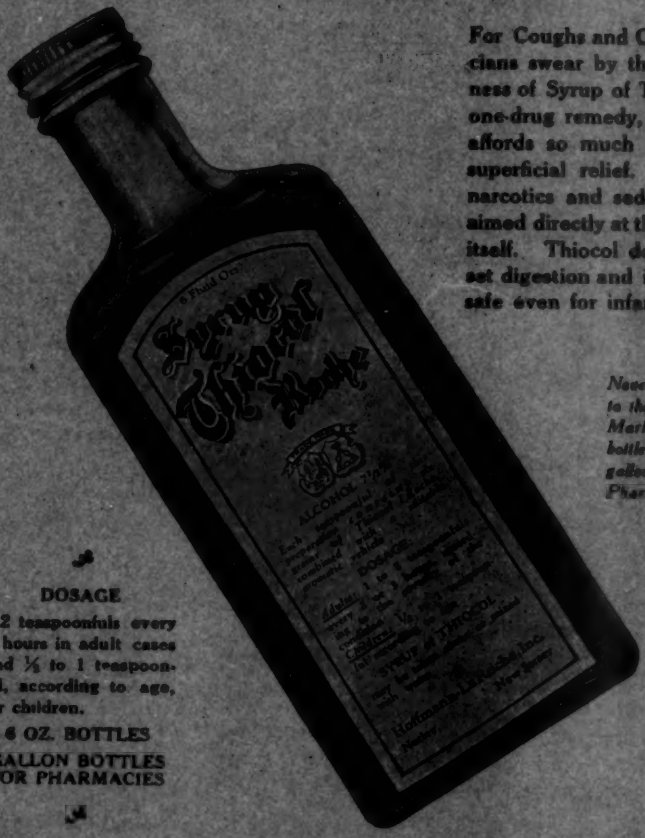

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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 102 FEBRUARY, 1930 NO. 2

EDITORIAL

E SCINTILLA LUX

THE OFFICERS in charge of the administration of the Federal Food and Drug Laws are actively prosecuting cases in which flagrantly fraudulent preparations are offered to the public. The name of these might be "legion," for they are many. Some information as to the appalling nature of the frauds practiced on the sick was given in an editorial in a recent issue of THIS JOURNAL. Unfortunately, courts are often lukewarm and occasionally even hostile to the attitude of the food authorities. Many defendants escape with light penalties and some with none.

A recent decision by a court of appeal puts such a satisfactory intepretation upon the phraseology of labels as to deserve special notice. The data are fully set forth in report of case No. 16,387, in "Notices of Judgment under the Food and Drug Act," issued by the United States Department of Agriculture, December, 1929. The technical title of the case, in accordance with the custom of the prosecution of listing the action against the article libelled, was United States v. 48 Bottles of Fulton's Compound RX 1 et al. The defense was that no claim was made by the maker of the article, all claims being merely reports from others, including a few physicians, whose names were not given. The lower court accepted the defense and dismissed the libel. Appeal was taken to the United States Court of Appeal for the Ninth District, Judges Rudkin, Dietrich and Wilbur sitting. The opinion was written by Judge Dietrich as follows:

"The point of the exception is that nowhere in the label, wrapper or attending circular does the proprietor or shipper make any direct

statement or representation that the drugs are of curative or therapeutic value. In each case there is the statement 'We have received many letters from physicians reporting,' followed by what is represented to be the substance of such 'reports,' which admittedly would tend to engender a belief to persons suffering from diabetes or Bright's disease that the use of the drugs would likely afford them relief. Unless we discredit their mental competence, such, we must presume, was the intent and expectation of the proprietors. Their contention is that they have such letters or reports and that that fact constitutes a complete defense whatever may be the character of the drugs. But if, as is alleged, the drugs are worthless the proprietors cannot escape responsibility by hiding behind the phrase 'the doctors say.' Couched in such language undoubtedly the printed matter makes a more persuasive appeal to the credulity of sufferers from these diseases than if the representations thus implied were made directly upon the authority alone of the proprietors, and for that reason they are not less but more obnoxious to the law. The charge is that they are not only false but fraudulent, thus implying had faith on the part of the appellee, and of course we are presently concerned only with the sufficiency of the charge and not at all with the character or degree of proof required to substantiate it. The point does not require extensive review of the decided cases for conclusive, we think, is the principle of construction set forth in the following quotation from the opinion of the Supreme Court in United States v. 95 Barrels of Vinegar, 265 U. S. 438: 'The statute is plain and direct. Its comprehensive terms condemn every statement, design and device which may mislead or deceive. Deception may result from the use of statements not technically false or which may be literally true. The aim of the statute is to prevent that resulting from indirection and ambiguity, as well as from statements which are false. It is not difficult to choose statements, designs and devices which will not deceive. Those which are ambiguous and liable to mislead should be read favorably to the accomplishment of the purpose of the act.' "

At the rehearing of the case, the defendant company did not further contest the decision and the material was ordered destroyed.

HENRY LEFFMANN.

EDUCATION AND RESEARCH*

MORE THAN one hundred years ago Daniel B. Smith, one of the founders of the Philadelphia College of Apothecaries, later the Philadelphia College of Pharmacy, and now the Philadelphia College of Pharmacy and Science, made a statement in his annual address to one of the earlier graduating classes which required both courage and understanding. He said: "We must educate the young men of today so that they will be better pharmacists than their preceptors."

It takes a brave man to make such a statement and then live up to it. He was speaking particularly of education, for organized or purposeful research was unknown at that time. That was the time when Faraday was tinkering with wires and wheels and electric currents and discovered the principles underlying the dynamo.

One of the members of Parliament, who had a contempt for science as being of no practical value, asked Mr. Faraday what use he expected to make of this revolving electrical toy, and Faraday replied, "It does not seem to have much use at present, but some day you legislators will be able to tax it."

Some few years ago I tried to picture the calamitous result to the world if all research should stop, and suggested that some organized effort be made by your association to initiate something tangible and worth while in the shape of a research program. Up to the present time I have heard of no action having resulted from this appeal.

I shall now repeat it, and shall broaden it so that you may act individually and not wait for a committee to be appointed and to waste time in discussing the obvious. Every one of you is interested in the status and progress of retail pharmacy, for your very existence depends upon a healthy condition of the retail trade. Are present conditions perfect? Could any improvement be made? Would you not like to see pharmacy upon a higher professional plane than it appears to be today?

Then you should support pharmaceutical educational institutions, not only with applause and approval, but with funds for adequate endowment for both scientific and educational progress. I am writing impersonally now, not especially in favor of the institution

*Reprinted from the Annual Report of the *Philadelphia Drug Exchange*.

with which I personally am identified, but for all educational institutions in which pharmacy is taught. They all need more money than their present budget allowance permits them to spend.

Do you know that more than two billions of dollars were given to educational institutions last year, of which less than 0.005 per cent. was given to pharmacy colleges? What is the matter? Are wealthy pharmacists ashamed of their alma maters, or are they afraid to give anything because it will subject them to annoying publicity and requests for help from many sources? The remedy then is to give anonymously. If you are really interested in an institution, you should not need the advertising of your gift as a necessity. More than ten million dollars were given anonymously last year to educational institutions in America by generous-spirited souls *who wanted to give* but did not want publicity. Only a few thousands of this total reached pharmacy colleges.

As long as you are in business you will be dependent upon pharmacy. Why not help it now or provide or plan for financial help later? Thus, and thus only, will pharmaceutical research receive its due, for upon the results of pharmaceutical research many fortunes have been accumulated by those who have spurned the ladder by which they rose to affluence.

CHARLES H. LAWALL.

ORIGINAL ARTICLES

THE QUALITY OF COMMERCIAL ETHER*

By Henry Leffmann and Charles C. Pines

SEVERAL GRADES of ethyl oxide are common in the market. Two especially need supervision—the anhydrous for analytic work and that for anesthesia. The quality of the latter and methods of testing are provided in the pharmacopeias of the several nations. Some discussion has lately arisen concerning the possibility of anesthetic ether producing irritation and even inflammation of the respiratory tract. An editorial in *Industrial and Engineering Chemistry* (1929, 21, 995) mentions a specific case, in which aldehyde and

*Published, by agreement, jointly with the *Bulletin of the Wagner Free Institute of Science of Philadelphia*, February, 1930.

peroxide were found in a hospital sample that had apparently caused serious irritation. Unfortunately, no information is given as to name, place, source of the sample or the tests used. Irritation and even serious gastric disturbances may be caused by inhalation of ether. Much depends on the manner of administration. One of us (L.) has been twice under the influence of the drug, administration being on both occasions by well known surgeons. One of these had little experience in inhalation and his method produced much disturbance. The other had paid much attention to such administration and had devised several forms of inhalers. He gave the ether skillfully, anesthesia being produced rapidly and smoothly. L. has also seen many operations in which ether was used and has noted much difference in susceptibility. In the purest form it is somewhat irritating and in view of great prevalence of respiratory troubles at the present time owing to the air impurity in our cities, it is not surprising that inflammation should occasionally develop.

Notwthstanding these facts, it is incumbent upon manufacturers to keep their product as pure as possible, and makers of pharmacopeias must provide comprehensive and trustworthy control tests. In the practical application of these rules, supervision must come from federal and state authorities. Retail druggists cannot be expected to carry out the complex procedures necessary for such control. In hospitals, of course, the laboratory can do much towards preventing the use of impure materials.

A comprehensive study of commercial ether and of the tests for impurities carried out by Baskerville and Hamor was published in *Industrial and Engineering Chemistry* (1911, 3, 378). They reviewed a large number of tests, determining limits of delicacy, possibilities of errors of inference, and gave a summary suggesting procedures to which a given sample should be submitted in order to assure its suitability for anesthetic use.

The discussion that has recently arisen relates, as noted above, to the presence of aldehyde, presumably acetaldehyde, and peroxide, possibly hydrogen peroxide. Tests for these classes of impurity are fully reviewed in the paper above noted, but it must be borne in mind that it was published eighteen years ago. Since then, considerable progress has been made in the field. This seems to be especially true of the discussion of the use of the fuchsin-sulphurous test for aldehyde. B. and H. do not give the method they used in preparing the test solution. We have used with much satisfaction the formula

proposed by Fincke (*Zeits. Unters. Nahr. Genuss.*, 1914, 27, 248, also *Amer. Jour. Pharm.*, 1927, 99, 289). The solution differs from the usual formulas by containing much more hydrochloric acid. We have been using a solution that was made several months ago, still entirely satisfactory, having been kept in the dark. We have investigated the action of this solution on samples of commercial ether with the following results. It must be borne in mind that the test is very delicate and also that it seems that tin containers in which ether is usually sold may have a direct action in developing acetaldehyde or some substance giving a similar reaction.

The first four samples are anesthesia ether. The color was observed after fifteen minutes.

	Source and Type of Sample	*Container*	*Reaction*
1.	†——— (very old sample) ..	Ordinary tin	Very marked red
2.	——— (recent sample)	Patented tin	Very faint tint
3.	———	Ordinary tin	Very faint tint
4.	———	Ordinary tin	Distinct red
5.	———	Ordinary tin	Distinct red
6.	———	Amber bottle	Extremely faint tint
7.	———	Ordinary tin	Distinct red

It is interesting to note the very faint reaction given by that in the glass bottle, the only sample in the lot so preserved. Nessler's Solution gave results in complete accordance with those in the above table.

Finding Merck's anhydrous ether so nearly free from anything reacting with the Fincke solution, we used it for testing the delicacy of the reaction. One drop of a solution containing somewhat less than 1 per cent. of acetaldehyde was added to 25 cc. of the ether. After mixing, a small amount was tested. After fifteen minutes a very faint tint was noted. A similar experiment was then made with two drops of the acetaldehyde solution to 25 cc. A faint but distinctly noticeable tint was produced after fifteen minutes.

The existence of peroxides in ether has also been noted. Baskerville and Hamor gave full attention to this phase and discussed the tests for the substances which are often assumed to be, principally, hydrogen peroxide, but may, of course, be other forms. We studied

†The Author will supply the names upon request.

the reaction with acid dichromate, using a solution containing 1 grm. of potassium dichromate and 5 cc. of strong sulphuric acid in 100 cc. of water. About 1 cc. of each of the above samples was placed in test tubes and 1 cc. of the dichromate solution dropped in. By this means the reagent passes *through* the sample to be tested, and if a peroxide is present the reaction occurs at once. The liquids should not be shaken, nor should the ether be poured on the reagent. (The same method was applied by us in testing for aldehyde. Equal portions of the reagents were poured into approximately equal portion of the several samples). In the test of the seven samples for peroxide, anhydrous ether sample 5 gave a faint bluish tint, but nothing was noted in the others. Fifty cc. of this sample was then mixed with one drop of hydrogen peroxide (U. S. P. X) and a small portion tested. A distinct blue tint appeared promptly. The addition of two drops to the unused portion of the mixture showed a deeper blue.

So far as the anesthetic ether on the market is concerned it appears to contain but little acetaldehyde, if fresh, but it seems that plain tin containers tend to cause changes by which this substance is produced. The quality of sample 6 marketed in an amber glass bottle, is worthy of note.

Tests for peroxide with vanadic oxide and that prescribed by U. S. P. X were made on all the samples. Vanadic oxide gave a distinct color with No. 5, but no appreciable effect with the others. The U. S. P. test gave a slight reaction with No. 1 and a strong one with No. 5. Pieces of starch paper were dropped into these samples. No. 1 acquired after some time a faint blue tinge, especially on the edges, but the paper in No. 5 became soon deep blue throughout. The iodide test seems to be very severe. For practical purposes the chromic acid test will probably suffice. The delicacy of the chromic acid test is shown by the fact, one drop of U. S. P. X hydrogen peroxide in 25 cc. of anhydrous ether (chosen on account of having been marketed in glass) gave promptly and distinct a blue when a volume of a few cc. was tested by dropping acid chromate solution through it. Since 100 cc. of the hydrogen peroxide contains as nearly as may be 3 grm. of real peroxide, 1 cc. will contain 30 milligrams. One drop is about one-fifteenth of a cc., so that the amount of peroxide added to the 25 cc. of ether may be safely assumed as 2 mg.

Sample No. 2 was transferred to a bottle and the container opened. It was lightly copper plated on the side and base, but the top was plain tin. The whole plated surface was tarnished and the soldering lines were bare. Containers of such construction standing quietly in the laboratory for even a considerable time will not give correct results regarding the effects of the plating. The liquid does not come in contact with the unplated top. In transportation by railroad or truck much shaking will occur and boxes may be packed so as to invert the cans they contain. The slightly higher aldehyde content indicated in sample No. 3 may have been due to the long distance it had been transported into this market.

We desire to thank The Philadelphia College of Pharmacy and Science for permission to use the laboratory equipment in this investigation.

Summary

Disturbance in ether anesthesia may be due to improper methods of administration or special susceptibilities, systemic or local. Aldehydes may be present in small amount even in the best grades, but are hardly likely to produce serious results. Peroxides are of infrequent occurrence.

Ordinary tin containers favor the production of aldehydes. In hospital practice all packages so furnished should be at once transferred to amber glass bottles, well corked and kept in a cool dark place.

Fuchsin-sulphurous acid, especially when prepared according to Fincke's formula, is a delicate test for aldehydes, much more convenient than that recommended by U. S. P. X. It may be necessary, however, to fix a toleration limit for practical control. The chromic acid test for peroxides is also very delicate and more convenient than that recommended in U. S. P. X. In both these tests the reagent should be poured *through* the sample to be tested.

All packages of anesthetic ether should bear on the label in conspicuous figures the date of packing.

Henry Leffmann Chemistry Research Fund,
Wagner Free Institute of Science of Philadelphia.

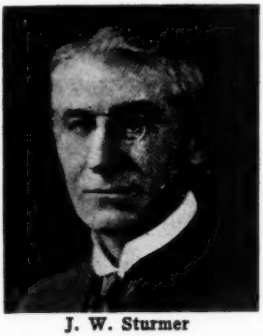
THE MODERN SUN CULT*

By J. W. Sturmer

Dean of Science, Philadelphia College of Pharmacy and Science

SUN-ENERGY

IN THE SPRINGTIME all vegetation awakens to renewed life. This transformation would be most astonishing if its annual recurrence had not taught us to accept it as a matter of course. The advent of the growing season which comes with unfailing regularity, is the result of more sun-energy, that is, more light, and with it, more heat rays which we can feel yet cannot see, and more, also, of that mysterious radiation which we can neither feel nor see, but which we now know to be a potent agency affecting all living creatures, namely the ultra-violet rays.



J. W. Sturmer

Our house plants have the habit of growing toward the sun, and we ourselves intuitively seek its light and warming rays. No physician need order us to do it; it is simply natural that we crave sunshine. Under its influence we are alert, active, optimistic, cheerful. When great lowering clouds hide the sun from us, we are apathetic, lethargic and gloomy. "Diogenes", asked Alexander the Great, "what can I do for you?" "What boon would you beg of the all-powerful conqueror of nations?" "Step aside, Alexander", answered the old philosopher, who was not noted for tact or courtesy. "Step aside, and do not shut out my sunlight."

WINDOWS OF GLASS AFFECTING HEALTH

Primitive man was at one time a cave dweller. His house was dark. There were no windows. But the chances are that he was at home but little, that he lived largely in the open, and that only when the weather was extremely inclement did he take refuge in the dark hole in the rock which he called home. It is highly probable also that when the season permitted it, his apparel was not more extensive than

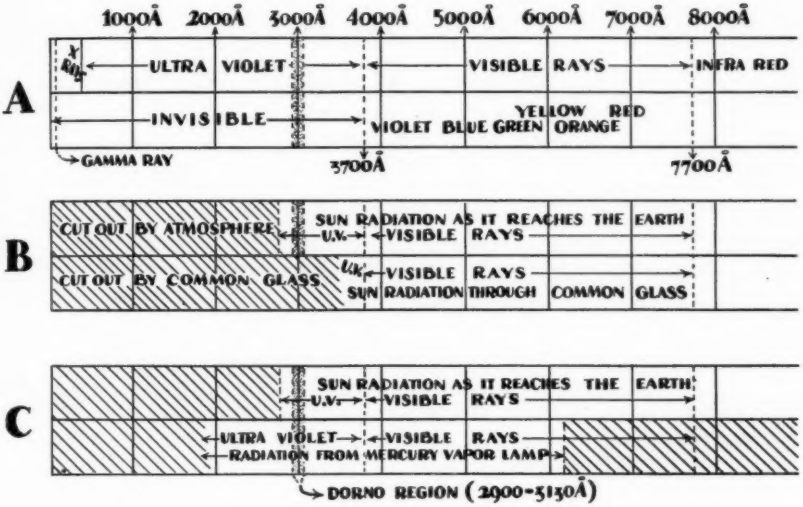
*One of a Series of Popular Science Lectures given at the Philadelphia College of Pharmacy and Science 1929 Season.

a modern sun-suit. We may be sure that he got his ultra-violet pretty generously, as did also his spouse and children. Unquestionably man is an out-of-door creature intended to live in the sunlight. And for thousands of years he so lived. But a few centuries ago a marvelous transparent substance was discovered, namely glass, and this discovery has in a marked degree changed the human habits of life and of work, for the cold months are now spent largely indoors, behind this glass, which shuts out the wintry winds, but transmits sunlight, and with it some of the warmth of winter-sunshine. Unfortunately, however, and this was unknown until quite recently, glass does not transmit all the kinds of sun-energy which we need, for the rays of shorter wave lengths than those of light are in large measure intercepted by glass and so these rays now fail to reach us. Thus we receive in our homes, and even on our sun-porch, a vitiated and abnormal sun radiation—a radiation which has lost something, something imperceptible to our organs of vision, but which we require for our physical well-being.

EFFECTS OF SUN ACTIVITY

The sun is about 93 millions of miles distant. Its enormous mass exhibits tremendous chemical activity, and it is radiating its substance—so scientists inform us—at the rate of several million tons per second. The sun-radiation thus engendered streams into space and only a relatively small per cent. of it reaches the planet on which we live. Yet, as this small portion of the total varies, we experience winter or summer, great heat or extreme cold: our vegetation flourishes or dies; our hills are green, or they are white with a covering of water crystals from the skies; our continent experiences a glacial period, or an age of tropical warmth.

The sun-radiation vaporizes the waters on the earth and forms clouds, fog and rain. It stirs up the atmospheric mantle which surrounds our planet and causes winds to blow—gentle spring zephyrs, or devastating tornadoes. It develops the green and the yellow pigments in leaves and the riot of colors in flowers. It also makes the vegetable cell function as a chemical laboratory in which water and the carbon dioxide of the air form plant substance, and thus our plants grow, producing our food, our shelter and our raiment. Even our fuels, gas, coal and oil, have a sun-energy origin, and the modern cliff dweller in his steam-heated apartment, reading his newspaper under the incandescent Mazda, gets light which originated in the sun, no matter whether the electric current he uses is generated from coal or



A. The radiation designated as ultra-violet comprises the wave-lengths ranging from the x-rays to the visible spectrum, which begin at about 3700Å. The visible rays extend from this point, which is sometimes given in round numbers as 4000 Å to about 7700 Å. Then follow the penetrating infra-red rays, up to about 1400 A, and beyond these the long-wave infra-red rays, lacking in penetrating power and known as ordinary heat rays. The ultra-violet range may be divided into three zones: The first zone, up to waves of about 2000 Å are rays at present of scientific interest rather than of practical application, but are known to be dangerous. The next zone, from 2000 Å to about 3000 Å, comprises the bactericidal rays, the germ-killing power being strongest between 2380 Å to 2490 Å. Beginning at about 2800 Å and extending to the visible violet (about 3700 Å), we have the health rays, the ultra-violet which comes to us in sunshine. From 2800 Å to 3300 Å the rays have pigmenting effect—can produce tan or freckles, depending upon the development of a skin pigment called melanin. But only the rays from 2890 Å to 3130 Å can develop vitamine D in the human skin. This is the Dorno region. Hence the rays from 2800 Å to 2890 Å and those from 3130 Å to 3300 Å can produce tan without developing vitamine D, and a transmitting medium which permits the passage of rays producing tan is not necessarily satisfactory from the health standpoint.

B. The rays of the Dorno region are filtered out of sunshine by common glass. But these rays are not necessarily shut out completely if the radiation is of great intensity as it may be had from a powerful ultra-violet lamp. The thickness of the glass must, moreover, be taken into consideration. A glass which shuts out the Dorno rays from sunshine may transmit them partially as they are emitted from a lamp.

C. Ultra-violet lamps differ not only in the range of wave-lengths which they provide, and in the intensity of total radiation, but also in the relative intensity of the wave-lengths within the Dorno region as against the other ultra-violet rays produced. Lamps are tested, compared and standardized by means of the Dorno Cadmium Cell, an electrical contrivance the construction of which is based upon the sensitiveness of cadmium to the wave-lengths from 2890 Å to 3130 Å.

by water power. We are warmed by the sun, fed by the sun, and clothed by it, just as was primitive man, ages before us.

WHAT IS SUN-ENERGY?

Now what is it that the sun sends to us through 93 million miles of space? Is it a stream of electrons? So it would appear. But we had better not be dogmatic on this subject which is linked with the fundamental concepts of energy and matter—concepts which have been modified quite recently, and may soon be modified still further. Most physicists now subscribe to the corpuscular theory, in accordance with which light, and the ultra-violet and the heat rays as well, come from the sun as a stream of corpuscles, emitted in a succession of bursts, but the latter so close together, and following one upon the other with such inconceivable speed, that the stream is, as far as we can perceive, continuous and unbroken.

WAVE-LENGTHS

When, however, solar radiations are to be dealt with in their practical aspects, as for instance in regard to reflection or refraction, it is the other theory of light, the wave theory, that provides the nomenclature. So we continue to speak of wave-lengths, and of wave frequencies, just as we do in radio parlance. Indeed, it is generally accepted that certain light waves may be "tuned in," and other light waves refused entry. On this basis we explain the phenomenon of color. But to understand the explanation we must remember that the light waves of the different colors of the spectrum differ in length; that the red waves are the longest, and that the waves become shorter and shorter, through the orange, yellow, green, blue, and violet, the latter being less than half the length of the red.

ULTRA-VIOLET

It must not be assumed that ultra-violet rays are of a single wave-length. On the contrary, they embody a range of wave-lengths, just as light rays represent a range. The longest waves of ultra-violet are just a little shorter than the shortest violet waves. They are thus just *beyond* the violet-rays of the spectrum. Hence the term *ultra*-violet. It is not quite correct, however, to speak of ultra-violet light, for light is visible, while the rays of shorter wave-lengths than those of light are invisible. Hence we had better use the term ultra-violet radiation.

THE ANGSTRÖM UNIT

We must bear in mind that the waves of light rays are exceedingly minute—too short to be measured by ordinary methods, and that we cannot conveniently express such infinitesimal lengths in fractions of inches or even of millimeters. And as the waves of ultra-violet rays are shorter still, the necessity for a special unit of length to be employed in the measurement of such minute waves is obvious.

The unit most generally used is called the Ångström unit, and was so named in honor of a Swedish physicist by the name of Ångström. It is a metric unit, and represents $\frac{1}{10,000,000}$ of a millimeter, the millimeter being equivalent to about $\frac{1}{25}$ of an inch. Now in terms of this unit visible light ranges from about 3600 Ångström units, (Å), to about 7700 Å—although it must be remembered that the human organs of vision vary in their range, and that many persons cannot see the rays of wave-lengths as short as 3600 Å, nor those of wave-lengths as long as 7700 Å.

WAVE-LENGTHS OF ULTRA-VIOLET

Wave-lengths shorter than 3600 Å, and down to about 1000 Å, constitute the ultra-violet radiation. The shorter the waves, the higher the frequency, that is, the larger is the number which pass a given point in a unit of time. All solar radiation travels at the same inconceivable speed of about 186,500 miles a second, thus being capable of encircling the earth more than seven times in that short period. This applies to ultra-violet as well as to visible light, just as it does also to the very long waves which carry our radio programs. This means that the rays from ultra-violet lamps reach us so speedily—if they are not absorbed by an intervening medium—that we have no time to side-step them, even though we may stand at some distance from the lamp. We can protect ourselves only by the use of an intercepting medium.

The radio waves, many city blocks in length, the infra-red, visible light, ultra-violet, and X-rays, all seem to be fundamentally the same, except in the matter of wave-lengths and conversely in the rapidity with which the waves follow one upon the other; but by virtue of this variation they exhibit a most decided difference in penetrability and in their action on inanimate objects and on living organisms.

SOURCE OF ULTRA-VIOLET

An ordinary wood or coal fire emits light and heat rays, but no appreciable ultra-violet radiation. If, however, carbon disulphide is burned in a stream of oxygen, the flame which exhibits intense white light, emits also ultra-violet radiation. So ordinary combustion can be the source of these mysterious rays. But carbon disulphide is a substance both dangerous and malodorous, and its use in lamps for the production of ultra-violet is limited to laboratory experiments.

ULTRA-VIOLET LAMPS

The practical ultra-violet lamps are types of electric lamps. This applies to those which are used for strictly scientific purposes as well as to the lamps now so largely sold for family use for the irradiation of the human body. To be sure, the lamps for scientific purposes are designed to furnish a greater intensity of radiation, and one embodying a wider range of wave-lengths. They are also provided with filters to intercept the light waves, which is not a necessity if the lamp is to be employed for therapeutic purposes, as for such uses the accompanying light waves seem to be desirable and certainly not objectionable.

Structurally the lamps may be divided into two classes: the exposed arc lights, and the lamps in which the radiation is produced within a bulb or tube. The principle upon which the majority of ultra-violet lamps are constructed is that an electric spark sent through the vapor of certain metals—iron, nickel, zinc, mercury, etc.—produces this radiation.

A common form of the arc type has carbon electrodes with metallic cores, or cores impregnated with metallic ingredients. But also carbons without metallic ingredients may be used, in which case a very wide arc (about two inches) is employed.

The other kind of lamp (always with a bulb or tube) is known as a mercury vapor lamp. Such a lamp may have electrodes of mercury, or these may be of some other metal, such as tungsten; but in either case the gap between the electrodes is occupied by mercury vapor which the current traverses and causes to glow with a greenish light, the invisible ultra-violet rays being produced with the light waves. The light from such a lamp does not include the longest visible waves, that is, it is devoid of the red and orange; and as a consequence the light is colored, for white is obtained when all the wave-lengths of the red, orange, yellow, green, blue and violet are produced. The lamps used for therapeutic purposes may be arc lamps or mercury vapor

lamps, but for scientific use the latter type of lamp is usually preferred.

A common form of mercury vapor lamp is essentially a specially constructed quartz tube, exhausted of air, and containing liquid mercury which may be made to separate, and thus an arc may be struck. The wires are connected in such a manner that the spark must jump from the one body of mercury to the other, thus traversing the gap occupied by mercury vapor.

Quartz is employed for the tube or bulb because of its remarkable transparency to ultra-violet rays, permitting penetration of wave-lengths as short as about 1850 Å. Only calcite and fluorspar are known to transmit yet shorter wave-lengths. For the lamps designed for therapeutic use, quartz need not be employed, as such lamps are planned to furnish only the ultra-violet rays of wave-lengths greater than 2900Å, these being the rays which come to us in sunshine. Thus a special kind of glass may be made to serve for the tube or bulbs, and the employment of quartz is not necessary for family sun lamps. Lamps embodying bulbs or tubes are known to become less efficient with use. This progressive loss of efficiency is largely due to changes which the radiation effects in the quartz or glass, probably a gradual de-vitrification, and a discoloration because of the deposition of particles by sublimation.

FILTERING OUT LIGHT WAVES

The filters used to cut out the light waves, so that only the ultra-violet may be transmitted, are either plates of quartz on which a thin film of silver has been deposited, or they are glasses deeply colored with certain metallic ingredients.

THE INVISIBLE BECOMES VISIBLE

When the invisible ultra-violet rays, unaccompanied by light rays, are caused to fall upon certain objects, an astonishing phenomenon may be observed. Objects which in common light have color, may change color; and objects which are commonly colorless, may exhibit color—may show red, orange, yellow, green, blue, or violet—any color of the spectrum. Thus, the fingernails, the teeth, and the eyeballs, glow with a pale yellow light. A crystal of calcite looks like a coal of fire; a crystal of fluorite shows a beautiful violet-blue. The zinc ore called Willemite, glows brilliantly with a yellow-green light. Indeed, many chemicals, in ultra-violet light, show characteristic color-effects. Thus, calomel, exhibits a brick-red color, sodium salicylate is violet-blue,

quinine, violet; petrolatum, light blue. The explanation of such extraordinary effects is that these substances, and many others which show color under ultra-violet, have the property of reducing the latter radiation to longer wave-lengths, effecting a step-down, as we might call it, and thus bringing the rays within the range of the visible spectrum.

FLUORESCENCE

This phenomenon is called fluorescence, because it was observed first in the mineral fluorite.

Not only the color, but also the intensity of the fluorescence, varies greatly. Thus, for example, both sodium and potassium salicylate show a violet-blue; but the fluorescence of the sodium salt is much more pronounced. Again some solids which show little or no fluorescence, may develop it to a marked degree when they are dissolved in an appropriate solvent. The examination of substances under ultra-violet is a new development in science, and one which gives promise of many applications in solving problems in practical chemistry.

Certain substances fluoresce with a red light, that is to say, they step down the invisible rays to about 7000 Å. If the waves coming from the chemical when it is subjected to ultra-violet are mostly waves of about 5500 Å, these will appear to our eyes as green; and so on through the range of colors which are seen in the rainbow. But we must remember that just as visible light represents not a single wave-legnth but a range from about 7700 Å to about 3600 Å, so does ultra-violet radiation represent a range of wave-lengths, beginning where the shortest waves of the visible spectrum end, at about 3600 Å, and diminishing in length to about 1000 Å. Immediately beyond the ultra-violet there lies an unexplored field; and then, farther on, in the neighborhood of 100 Å there are the X-rays concerning which we have some definite knowledge. And, lastly, beyond the X-rays, come the shortest waves known to science, the gamma-rays, from radium, and beyond these the cosmic rays about which we now are receiving rather startling information.

ABSORPTION OF ULTRA-VIOLET

We are all familiar with the fact that some substances, like soot, absorb all the rays of common light, and hence appear black, while other substances reflect indiscriminately all the wave-lengths of light, as does this paper, and hence appear white. We know also that many substances exhibit

selective absorption, failing to appropriate the red, the yellow, the green, or the blue, and thus possess the colors of the wave-lengths which are not absorbed.

Now ultra-violet, speaking generally, is much less penetrating than the longer waves which we can see, and this feeble penetrability diminishes more and more as the wave decreases in length. The opacity of most known substances to the ultra-violet radiation has tended to make its study difficult, and it was not until the technique of making quartz glass had been perfected that much headway could be made. But in fused quartz we have a medium transparent to waves as short as 1850 Å. For the study of still shorter waves certain minerals, namely fluorite and calcite, are employed. But the waves shorter than 1850 Å have at present no practical application, so the quartz glass serves very acceptably.

THE WAVE-LENGTHS WHICH PASS THROUGH THE ATMOSPHERE

Solar radiation is rich in ultra-violet. Just how rich, and what its range of wave-lengths may be, we do not know, perhaps shall never know, for our atmosphere, even when it is clear, cuts out all the wave-lengths shorter than those of about 2900 Å. What is known concerning the shorter waves has been learned through the study of radiation artificially supplied by arc lights and lights from sparks through metallic vapors.

ULTRA-VIOLET THROUGH GLASS

Common glass transmits only the longest waves of ultra-violet radiation, those which are longer than about 3400 Å, and hence are in the neighborhood of the visible violet light waves. This explains why a sunporch furnishes impoverished sunlight. But in recent years special kinds of glass have been made, designed to transmit the solar ultra-violet more generously. The claim is made that this glass transmits about 65 per cent. of the invisible active rays, a statement which requires explanation. The facts are these: not 65 per cent. of all the ultra-violet waves of sunshine pass through in the same proportion in which they occur out of doors, but rather 65 per cent. of the radiation, with a much greater absorption of the shorter waves—even a total absorption of some of them—and a lesser interception of the longer ones. In other words, these so-called ultra-violet transmitting media do cut out an appreciable amount of the wave-lengths shorter than about 3000 Å.

THE DORNO REGION

The significance of the interception of wave-lengths shorter than about 3000 Å by the special glasses, and of all wave-lengths below about 3300 or 3400 Å by common glass is better understood when it is known that the rays which produce the beneficial effects on the human skin connected with the production of vitamine D are those of wave-lengths from 2900 Å to 3130 Å. This region of the ultra-violet range of wave-lengths is known as the Dorno region, and embodies the rays used therapeutically. These are the rays which are desired chiefly also in the radiation from the ultra-violet lamp. Rays of wave-lengths from 2800 Å to 3300 Å are kown to produce pigment, but particularly is this effect said to be due to the wave-lengths of the Dorno region. It appears that tanning is nature's protection against too much ultra-violet radiation of the wave-lengths which cause the chemical changes in the skin, for when the tan has become deep enough, the Dorno rays no longer penetrate, but are absorbed by the pigment and changed to heat rays.

WINDOWS

Window panes of quartz glass, SiO_2 give, of course, the best results in the transmission of the ultra-violet of the Dorno region; but only quite recently has the manufacture of quartz window panes been placed on an industrial basis, and unfortunately the price is still too high to admit of their general employment in the windows of solaria. The other types of ultra-violet transmitting glass, though not as satisfactory, are much cheaper. A still cheaper substitute is celophane, which is essentially a transparent sheet of cellulose. This substance transmits the radiation quite well, but it lacks durability, and requires a specially constructed frame.

DOSAGE OF SUNSHINE

How much sunshine do we need? Sunshine, like heat, food, or medicine, or any other agency which affects us, must be taken in proper apportionment. There is such a thing as too much food. Certainly, such a thing as too much calomel. That too much heat hurts us, we learn in early childhood. Sooner or later we learn also that too much sunshine is harmful. And an extensive and deep sunburn is not only painful, but like any other burn, is dangerous, resulting in cell destruction, with the generation of toxines, which cause systemic poisoning. Thus even sunshine must be taken in proper dosage. Fortunately, however, sunshine does not ordinarily harm us if we accustom ourselves to it

gradually, and thus avoid sunburn. This remark, however, applies only to persons who are well, for in certain diseases even strong sunshine may be detrimental.

PROTECTION AGAINST ULTRA-VIOLET

If we are interested in protection against ultra-violet rather than in its transmission, we need but remember that substances which allow only the longer waves of the visible spectrum to pass—amber glass, red glass, orange and yellow glass—will prove opaque to ultra-violet, while a medium which cuts out the red end of the spectrum and transmits the violet and blue, will prove to be rather transparent also to the adjacent invisible waves just beyond the violet. Thus blue cobalt glass transmits some ultra-violet, while red glass and amber glass filter it out, together with the short wave radiation of the visible spectrum, namely the violet, blue and green.

It will be seen, in the light of this fact, that the practice, formerly in vogue, of keeping the light-sensitive chemicals in blue glass bottles, was a misguided procedure, destined to prove ineffectual, while our present-day practice of employing amber glass, is founded on sound principles and is much more effective.

Another means employed to shut out ultra-violet is to interpose a fluorescent substance as a protective, for such a substance will transform this radiation into visible light waves. The cold creams and ointments specially devised to protect against sunburn are compounded on this principle, and contain fluorescent material. Even the ointment bases are fluorescent.

That sunlight deleteriously affects house paint is well known, and we have all observed how much longer paint lasts on the north side than it does on the southward exposure. The inclusion of a fluorescent material is, therefore, of benefit in house paint. Now zinc white is such a substance, and its employment in the paint materially lowers the penetration of the ultra-violet rays which are so destructive to the linseed oil binder, causing the oxidized oil to disintegrate to powder, thus bringing about the result which the painter refers to as "chalking." Most face paint, also, is somewhat fluorescent, and is to some degree a protection against sunburn.

CLOTHING AND ULTRA-VIOLET

A few remarks about clothing may be relevant in this connection. A person exposed to the ultra-violet in connection with electric welding may receive a burn through his clothing. This is due to the intensity of the radia-

tion. But most clothing effectively intercepts the light rays and also the ultra-violet radiation of sunlight. Animal hair is quite opaque to solar ultra-violet. Only very white hair transmits it to a slight extent. This means that all woolen clothing is an effective ultra-violet filter, and that the modern male, promenading on the boardwalk receives practically no such radiation through his clothing. Silk also is fairly opaque, linen a trifle less so, while cotton is a bit more transparent. The most transparent textile is a loosely-woven rayon or artificial silk, which explains why the sex known during the Victorian Era as the weaker sex is on the way to becoming the robust sex. The girls are getting more solar radiation, hence more vitamine D. This in part explains it. I would not be guilty of a breach in tact and criticize feminine raiment, which by the way would be futile, for I know that in the past neither the facts disclosed by science, nor the admonitions of the medical profession, have had any influence on the fashions of dress. Hence it is probably fortunate that I have warrant for the statement that the feminine dress of today is in far closer harmony with the newer facts pertaining to irradiation as a health measure than is the modern attire of the male. Women have gone far, since Civil War days, in so changing the fashions as to provide for plenty of sun irradiation; and in this span of time the men, alas, have made progress merely to the extent of having shaved off their whiskers, and exposing their chins to the sun. Only on the beach at the seashore does the pipe-smoking sex get an even break when it comes to solar radiation. What should be done about this is a matter far beyond the scope of this discussion. We give it up.

SUSCEPTIBILITY TO SUNBURN

The human skin varies considerably in its tolerance of solar radiation. Light-skinned persons are more sensitive to it than are the dark-skinned, and in most individuals a tolerance may be slowly developed by progressively increasing doses—if one may use the term doses in this connection. Speaking generally, our arms can stand about half again as much as the chest, abdomen or back; the legs a little more than the arms, the backs of our hands about five times as much, and the palms about fifteen times as much, while the foot soles are most resistive, because here the skin is thickest, and the outer skin is a poor conductor of radiation. But persons who do not tan must be very careful in taking sun baths.

BURNS BY REFLECTED RAYS

A sunburn, unlike a heat-burn, does not become manifest instantly. We may receive an overdose of sun radiation and remain oblivious of the fact for three or four hours. Nor is it easy to judge how long we may with impunity subject ourselves to sunshine at any given time, for so much depends upon the time of day, the season of the year, and the atmospheric conditions. We should know, however, that not only the direct rays burn, but that diffused sunlight, and reflected radiation, does also; that, for example, we may sit in a boat under an awning and receive a burn. It should be borne in mind that much of our ultra-violet comes to us reflected from the sky, and that the north exposure of our house provides about half as much as the exposure facing the sun.

VARYING INTENSITY OF SUNLIGHT

It may, further, help us to guard against sunburn if we remember the fundamental fact that the lower strata of our atmosphere are particularly absorptive toward ultra-violet, much more so than the more rarified strata higher up, the curve of ultra-violet in sunshine being virtually identical with the arc described by the sun in its course from horizon to horizon, which explains why old Sol is so much more powerful near the middle of the day, and much feebler when in the morning and evening its rays travel a longer distance through denser strata. It is indeed a common observation that at sunrise and at sunset even the violet and blue of the visible spectrum is largely cut out, giving us a preponderance of reddish and orange light. And as a matter of fact, the ultra-violet is almost wholly intercepted at the same time.

WINTER-SUNSHINE

In the winter, the sun is not so high in the sky, and its slanting rays are for this reason relatively poor in ultra-violet, just as are those of the morning and evening sun. Furthermore, there may be fog, clouds and soot particles, all of which filter out the shorter rays. Soot is the greatest offender in this respect, and does much to deplete still further the enfeebled sunshine of the cold season of the year. Our industrial centers naturally suffer most in the matter of vitiated sunlight, for in order that we may keep warm, and that our wheels of industry may be kept spinning, immense quantities of soot are belched forth from our chimneys.

DEFICIENCY OF ULTRA-VIOLET

In other words, we are systematically sacrificing the short wave solar ultra-violet in order that we may have an abundance of the longer waves which keep us warm. Only in very recent years have we learned about the unhealthfulness of this practice, and have come to the conviction that something must be done about it. A paucity of solar radiation means, so medical men tell us, a slackened metabolism, an enfeebled condition, a lowered resistance to germ diseases. It has in fact been suggested that the gradual extinction of certain Indian tribes may be due largely to their altered dress, and their changed modes of life, resulting in inadequate sun-irradiation, which is so necessary to them. In children, regardless of race, too little sunlight may mean rickets, or tuberculosis; and it was indeed in the treatment of these diseases that solar radiation was first employed in a systematic way. The sun-cure is not, however, in reality modern, for Antyllus, a physician of ancient Rome, made use of it, and he practiced heliotherapy long before anything was known about vitamine D. It is interesting to know also that rickets is the disease which he treated with sunlight. But since his day much definite information has been brought to light, some of it by feeding experiments conducted with animals, both in the absence and in the presence of radiation. Curative procedures also have been engaged in, experimentally, an animals, and clinically on patients in hospitals.

VITAMINE D

It is now known that when the skin is irradiated with ultra-violet, pigmentation or tanning is not the only result. Far more important is the change experienced by a certain chemical substance in the skin, a substance which becomes activated to form a vitamine, namely, the vitamine now designated as vitamine D, which appears to be just as essential to the proper functioning of the human organism as is certain mineral matter which it is well known, we must supply in our diet. If, then, we receive, because of our abnormal modern conditions of life, too little sun radiation, the tiny laboratories in our skin fail to elaborate an adequate supply of vitamine D, and as a result, the life functions fail to go on normally and as they should, even though we may not develop a recognizable disease.

BOTTLED SUNSHINE

We may in such cases proceed in a manner suggested by the serum treatments. We may obtain from another living organism the substance which we fail to produce ourselves. If we cannot develop our own vitamine D, we may buy it, and take it as medicine or food. Now the codfish, and other fish also, possess an abundance of vitamine D, the source of which appears to be the marine algæ, which are eaten by shrimp and small fish, which in turn supply the vitamine much against their will to the larger fish. The vitamine D in fish is found principally in the liver, and it occurs in the oil expressed from fish liver. So cod liver oil has come to be known as "bottled sunshine" useful in the treatment of the diseases which develop because of an inadequacy of solar radiation.

HOW MUCH SUNSHINE IS ENOUGH?

But what amount of such radiation and how much ultra-violet is adequate? We do not know. Physicians recognize the diseased conditions which follow a dearth of sunlight but they cannot tell us precisely how much we must have. Hence we do not know how long we must be in the sunlight, how great an area of our body surface must be exposed to it, nor how long we can go on without irradiation. But we do know that in the winter at least we do not receive as much as we need.

SUNLIGHT CANNOT BE STANDARDIZED

As the ultra-violet rays in sunlight vary not only according to the season and the time of day, but also according to atmospheric conditions it is utterly impossible to determine with any degree of accuracy the dosage of sunlight needed in specific cases. Hence the helio-therapist has learned to proceed cautiously and experimentally. A sun-bath of an hour may be safe enough on a certain day, but may, at the same hour, and in the same length of time, on the day following, cause a severe sunburn. One cannot standardize sunlight with precision. In this respect, certainly, the ultra-violet lamp offers an advantage. For with the same apparatus, and with the distance from the lamp also the same, the time of irradiation practically determines the dosage. This dosage is now being worked out, although, of course, we must remember that some persons are much more susceptible than others to the radiation, just as individuals differ in their tolerance of our common drugs.

IRRADIATED FOODS

The substance in the skin which responds to the ultra-violet is associated with cholesterol, and a similar substance is found in certain plants associated with phytosterol, which suggested that probably the vitamine could be produced in certain foods by irradiation, thus making unnecessary the ingestion of the unpalatable cod liver oil. Irradiated grain foods, irradiated milk and similar products have given promise of usefulness. Such irradiated foods are now on the market, as are also concentrated products obtained by treating an impure ergosterol with ultra-violet rays. The dose of the latter product is extremely small, and an overdose is harmful. It is said to represent 100,000 times its weight of cod liver oil as far as the antirachitic effect is concerned. Strange to say, however, when ergosterol, or a food containing it, is irradiated too long, the vitamine becomes inactive. Indeed, the whole study of irradiated foods, and of cod liver oil substitutes generally, is still in its infancy, and much remains to be learned, if not in regard to the technique of their preparation, then certainly as regards proper dosage. A preparation of irradiated ergosterol has been approved by the Council of Pharmacy and Chemistry of the American Medical Association, and may be accepted as quite reliable. But such products should be considered as medicine, to be taken under medical supervision.

USE OF LAMPS

The same cautious course should be followed also in the employment of ultra-violet radiation when this is produced artificially. We know that sunlight does not ordinarily harm us if we avoid sunburn. But the radiation from arc lights or mercury vapor lamps embodies the wave-lengths shorter than those found in sunlight which comes to us filtered by the atmosphere. It is also more intense. For these reasons the radiation artificially produced is far more dangerous. But unquestionably, the contrivances to furnish ultra-violet and thus to compensate for our loss of normal sunshine, are, if used properly, of great value. It is not wise, however, to proceed to self-treatment without expert direction. Here also conservatism is the part of wisdom. Let those who have been specially trained, do the pioneering.

THE ZONES OF ULTRA-VIOLET RAYS

The radiation from an arc or vapor lamp produces violet, blue, green and yellow light waves, which can be filtered out; and also ultra-violet rays from the violet down to a wave-length of about 1850 to 1870 Å. Waves shorter than 1850 Å are cut out by quartz and are never found

in the radiation from a mercury vapor lamp. The waves of the Dorno region, 2900 to 3130Å, and the longer ones, have the action of sunlight, but are of course supplied in greater abundance. Like sunlight they stimulate metabolism, govern our calcium balance, increase the alkalinity and the iron content of the blood, sharpen the appetite, and may be used in the treatment of rickets, certain skin diseases, and of tuberculosis. Such skin irradiation produces a slight rise in the temperatures, which soon falls to normal. It does not affect the blood pressure. If prolonged, it can, of course, cause sunburn, and it may cause inflammation of the eyes, this being due mainly to the waves shorter than about 3050Å.

Waves shorter than 3000 Å are correspondingly more irritating and more dangerous to the eyes. Since these shorter waves are produced in the operation of electric welding, they are frequently encountered, and their dangerous nature should be kept in mind. Goggles of special glass, designed to intercept them, are worn by the persons engaged in such operations; the spectators, however, are not so protected, and must look out for themselves.

BACTERICIDAL RAYS

The waves shorter than 3000 Å and longer than 2000 Å are decidedly bactericidal, particularly those between 2490 Å to 2380 Å. But longer wave-lengths also have a killing effect on some germs, though in a much lesser degree. Indeed, this is true in a measure in regard to the violet, the blue, and the green of the visible spectrum. Speaking generally, the longer the wave-lengths, above 3000 Å, the less effective are the rays in the destruction of bacteria.

OZONE

Waves shorter than 3000 Å also convert oxygen into ozone, hence this substance is always in evidence when an ultra-violet lamp is in operation. Ozone is a very active oxidizing agent, and in dilution acts on us as a stimulant. It is interesting in this connection to note that the solar radiation forms ozone in the upper regions of the atmosphere, and that when the sky is clear, and when the wind is from the west or the southwest, some of the ozone is found at the earth's surface, thus augmenting the exhilarating effect of the outdoor air, when we are out for a stroll under such weather conditions. It may explain also why we are apt to feel less energetic when the wind is from the east, for then the ozone is absent. Old-fashioned fishermen may even contend that it provides

justification for their deep convictions to the effect that "When the wind is from the east, the fishing is the least." But no one gives credence to what fishermen say.

A NEW TOOL FOR THE CHEMIST

To the chemist the ultra-violet lamp has opened up new methods of identification. Since so many substances exhibit characteristic fluorescent properties, this fact may be utilized for identification and for the detection of small quantities of certain contaminations or adulterations. The ultra-violet lamp may be used in food analysis, in clinical chemistry, and in mineralogy to identify rock components. The modern Sherlock Holmes will use not only his microscope but also his ultra-violet lamp. In the examination of documents, to detect suspected alterations, to establish the authenticity—or the reverse—of old paintings, this strange radiation is of great assistance. In the paint industry it may be employed to study the resistance to sunlight of various paints and varnish mixture. Its applications for the chemist seem indeed almost endless. It is a tool of great value to the analyst as well as to the physician. But it must, of course, be handled with caution. Such a lamp is not a plaything.

ANCIENT AND MODERN SUN-WORSHIP

Man has since time immemorial recognized sunlight as a natural agency of paramount influence. Many primitive races worship the sun as a deity, a practice at one time quite general and extending over long periods of time. Our American Indians still conduct their sun-dances. The ancient sun-worship, not only in Africa and in Asia, but also in Europe, and on this continent, had its gruesome aspects, for it entailed, frequently, human sacrifice—sacrifice to the sun-god. The modern sun-cult, should, however, exhibit no such inhuman features. Only ignorance, leading to the reckless misuse of sun-therapy, can call for victims. Let us hope, therefore, that this new health-giving agency may be employed wisely and conservatively by the enthusiastic devotees of the modern sun-cult and that experimentation in this field may be limited to persons who have the necessary knowledge and skill.

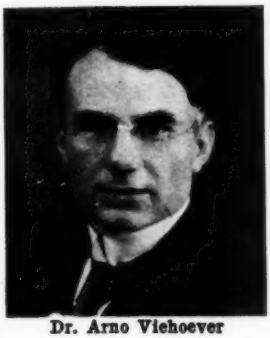
SOIL AND SOD

By Dr. Arno Viehoever

Director of Biological Laboratories and Experimental Gardens

"A youth goes forth in merry whim
To keep appointment with the Spring,
And as he goes each living thing
Seems bent and bound to go with him."

OUR VERY EXISTENCE and subsistence is closely linked up with the soil and the sod we live upon. The soil must be alive to support vegetation, the vegetation must be healthy to nourish man. Vast areas of barren rock, desert sand, sterile bogs—all waste lands—suffer under the sentence starvation or death.



Dr. Arno Viehoever

The spirit of life must be present and must be kept active below the surface to furnish a vegetative cover above. The character and vigor of this cover depends much upon the condition of the ever changing, intricate mass—soil.

The last 100 years have brought us so much definite knowledge of soil and sod that man can now discuss the relation and almost claim control.

I

Earth Crust

1. SOIL FORMATION

Our globe shows a crust formation of soils or rock debris covering a hot interior of still unexplored nature and most of the eighty or more chemical elements discovered by man are found in this soil-forming crust and many, as we shall see later, represent important constituents of life plasma—involved, of course, also in the formation of sod.

While people generally call this debris "dirt," few actually are aware of the complex nature of soil and of the relationship of its composition to the cover it carries. Underlying all other rocks—we find probably always those originating from fiery condition—the original, igneous eruptive unstratified lava rocks and deposition in water; through the transformation into rock or rocklike masses of plant and animal remains, e. g., peat, lignite, coal, lime, coral, are formed the sedimentary, stratified, geologically very important rocks.

Either rocks may be further changed into metamorphic rocks, representing especially the schists.

Almost the entire land surface of the earth is covered by a layer of disintegrated and decomposed solid rock. This rock weathered mainly by changes in temperature and by solution under loss of much material, forms an accumulation of stone debris often mixed with plant and animal remains. Where the surface layer, through weathering of the rock and decomposition of the organic matter, represents earth favorable for plant growth, we refer to it as soil. Sub-soil is the material directly underneath.

Fig. 1. Rock Formation and Disintegration Into Soil. (After Hovey.)
a. Manhattan Schist with Glaciated Surface. (U. S. G. S.)
b. Earth Crust showing Disintegration of Rock. (U. S. G. S.)

We find soils formed from granite, limestone, sandstone and shale. Marked differences exist between the soils according to the origin of the soil material as well as the factors which have changed that material into soil favorable to plant growth.

Muck and peat soils are formed in water filled depressions, lakes, ponds, without natural drainage—the wet conditions preventing complete decomposition of the organic matter.

SOIL COMPOSITION: ROCK—GRANITE

The oldest rock is granite, a most resistent stone, consisting of quartz (sand), mica, and feldspar—a double silicate of aluminum and alkali (sodium or potassium) metal. The gnawing tooth of time wears down this rock; water and carbon dioxide break down the feldspar.

The salt of the alkali metal is removed, leaving the aluminum silicate and water, chemically bound as clay. The quartz is liberated as sand, forming some sort of soil. View any solid rock, even the Hudson

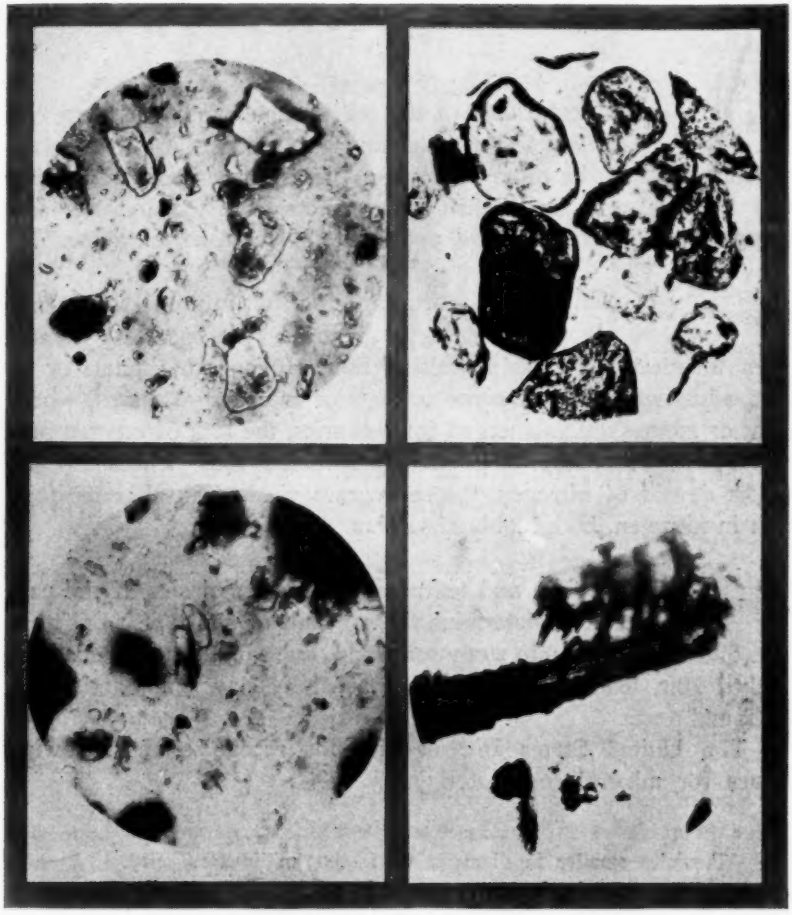


Fig. 2. Soil Constituents.
a. Disintegrated Schistose Rock, Showing Crystalline Structure Predominant.
b. Clay, Showing Crystalline and Organic Structure.
c. Sand, Crystalline With No Organic Matter.
d. Humus, Organic, Showing No Crystalline Structure. (Photos by Lewis.)

Palisades—and you see the tooth of time, the consequence of much decay, still more debris, clay, and sand and loam—the making of a better soil.

CLAY The weathered rock, representing hydrated silicate of aluminum together with the oxide and the acidic silicon dioxide, forms all kinds of clay, from white (kaolin) to grey —blue—red to mud. It is the storehouse for the fossils of great variety, the provider of some life—though "clay soil on farms bakes hard."

SAND Bleak sands of the sea of dunes and desert are fair examples of the ordinary sand, the silica, the dioxide of silicon. It is the other surface of the crust of earth, remaining after clay and mud are washed away, as more resistent to decay and change—a filter, not a sponge, poor indeed if used as soil alone.

HUMUS The organic portion of the soil, in progress of plant or animal decay, is humus. We speak of humus, when we mean the mass of rotting fallen foliage; of humus or of peat, when we make reference to bogs or marshes—swamps, where grass or mosses are submerged for centuries, the lack of oxygen preventing complete decay. The sphagnum mosses thus yield acid peats, almost devoid of nitrogen, the sedgegrass yields neutral peats quite high in nitrogen, both highly absorbent.

2. SOIL TYPES Origin and texture of the soil and size of the particles determine the soil unit or soil type. Soils are consequently divided into stony soil, sand, fine sand, sandy loams, fine sandy loams, loam, silt loam, clay loam, silty clay loams and clays, muck and peat.

The United States Bureau of Soils recognizes the following classes for mineral soil materials:

Class								
I	Particles	smaller	in	diameter	than	.005	millimeter,	clay.
II	"	ranging	between	.005	and	.05	"	silt.
III	"	"	"	.05	and	1.0	"	sand.
	"	"	"	.05	and	.1	"	very fine sand.
	"	"	"	.25	and	.5	"	medium sand.
	"	"	"	.01	and	.25	"	very fine sand.
	"	"	"	.5	and	1.0	"	coarse sand.
IV	"	"	"	1.	and	2.	"	fine gravel.
V	"	larger	than	2.			"	gravel.
	"	"	"	gravel				cobbles.
	"	"	"	cobbles				stones.

Davis and Bennett, soil workers of the United States Department of Agriculture, recently arranged, besides special soils, twenty principal and subordinate soil classes based on mechanical composition and texture and grouped them into three major classes according to clay content, namely:

General Soils

I	Soils containing less than 20% clay:	
	a—Soils containing less than 15% silt and clay	: Sand.
	b— " " from 15 to 20% " " "	: Loamy sand.
	c— " " " 20 to 50% " " "	: Sandy loam.
	d— " " 50% and more " " "	: Loam and silt loam.
II	Soils containing from 20 to 30% clay	: Clay loam.
III	" " 30% and more	: Clay.

Special Soils

I	Soils containing 65% or more organic matter *(sometimes mixed with silt, clay)	: Peat.
II	Soils containing 20 to 25% organic matter *(and sand, silt, little clay)	: Peaty loam.
III	Soils containing 25 to 65% organic matter *(and muck clay, silt, sand)	: Muck.
IV	Soils containing 30% or more of gravel up to 4½ inches in diameter	: Gravelly soil.
V	Soils containing enough stones over 4½ inches in diameter to hinder cultivation	: Stony soil.

3. SOIL PROFILES Veatch, of the Michigan Agricultural Experiment Station has discovered four general textural and structural profiles. He found

(1) that the surface layer of the virgin soil, in which there has been an accumulation of humus is higher in elements of fertility and less strongly acid, particularly in the heavier soils than the horizon of mineral soil directly beneath it;

(2) that there is a horizon of variable thickness, which lies just beneath the mold or humus soil, which represents maximum leaching and removal of the more soluble constituents, while at a shallow depth the soil reaches a point of maximum acidity;

*The field soilworker rubs the soil material in his hand to determine by the feel the pliability of the moderate moist clay soil, the good friability of other soils, the texture as light, sandy, heavy or clay, silty, loamy, clay loamy, etc.

(3) that lime or calcium carbonate has been leached or removed generally to depths of two to five or six feet; that the removal has taken place to greater depths in the sands than in the clays; that the sub-strata are universally calcareous or alkaline in reaction, most markedly so in clay and gravel, less so in sand;

(4) that there is a horizon (soil layer) at variable depths, but above the substratum, in which there is a maximum amount of clay and colloids, due either to weathering in place or to concentration or to both.

The profile analysis has an interest and significance not only to the scientist in soil classification, but also to the farmer who cultivates the staple general farm crops, the horticulturist, the forester, the

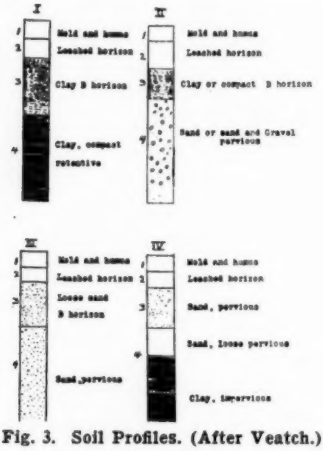


Fig. 3. Soil Profiles. (After Veatch.)

drainage engineer and the highway engineer. Certain soil types belonging in I and II profiles for example, may exhibit an acid plow soil, yet support a good growth of legumes when the roots have penetrated to the limey or alkaline soil which lies at shallow depths, while on certain types belonging to No. IV profile the plants may fail both because of greater depth to lime and greater acidity. Trees may send roots down to the clay substratum in the IV profile and exhibit a good growth on what is apparently an infertile sand, while on a type belonging in profile III the growth of the same species may be poor and the tree shorter lived. On certain soil types of this state, roots of trees have been observed to extend to depths of as much as fifteen feet, while on certain other soil types comprised in profile I, the roots of trees may flatten out at depths of only two or

three feet. The roots of grasses, clover and alfalfa have been observed to penetrate to depths of two to four feet or more. The average content of moisture or water is relatively high throughout the year in soil types comprised in profile I, while it is relatively low in profiles II and III and the movement of water freer. Soil types of sand texture in IV may appear dry at the surface, yet contain abundant moisture at shallow depths on account of the clayey and impervious nature of the deep substratum.

A knowledge of the virgin profile enables us to understand better the changes which have taken place in the plow soil due to cultivation. In many instances, due to erosion, horizon 3 of profiles I and II comprises the greater part of the plow soil which must differ markedly in plant response and tilth from the original top soil. Probably in most soils, the present plow soil represents a mixture of two or even three separate members or horizons of the virgin soil. Even in a forest or cut-over land the overturning of large trees may bring to the surface horizons of mineral soil quite unlike the virgin mold and humus in effect upon the plant, so that the growth of a seedling may be different in one spot as compared with another only a few feet away.

4. SOIL REACTION In the intimate relation of soil and sod, soil reaction plays an important role. The physical conditions, the chemical changes and the type and vigor of the soil population, the life of the soil, are greatly affected by the reaction of the surrounding medium. Ideal soil conditions in turn are the main basis for luxuriant plant growth.

A soil containing freshly rotting leaves of oaks, bark, pine needles, spruce or hemlock, acid peat, plowed under crops, usually turns sour (acid). In contact with limestone rock its reaction changes. Lime (limestone or marl) added to sour soil makes the soil neutral or sweet (alkaline). Ammonium sulphate, aluminum sulphate or tannic acid added to sweet soil neutralize the alkali and then sour the soil.

Water (H. O. H.), necessary for all changes of reaction, is electrolytically dissociated in equal numbers, if neutral, of electrified hydrogen (H) ions and hydroxyl (OH) ions. Actual excesses of OH ions are responsible for the degree of alkalinity, excesses of H ions for degree of acidity. These ion concentrations can be determined either colorimetrically with special indicators or electrometrically with potentiometers, registering the degree of electrical conductivity.

The values found by agreement are expressed as the potential due to hydrogen : ph; defined as the logarithm of the denominator expressing the normality of hydrogenions as normal tenth—normal hundredth, etc. The hydrogenion concentration of pure distilled water is normal/10,000,000 th. gram equivalent of hydrogenion; the ph value therefore would be 10,000,000, which is 7, the neutral point of the ph scale.

In this country Dr. Wherry, of the United States Bureau of Chemistry and Soils, has collected, mostly through field tests, a large number of data on soil reaction preferences of plants. He also suggested a certain nomenclature which has been adopted in the scale and statements of his findings utilized in this paper.

Scale

SOIL REACTION IN HYDROGEN ION CONCENTRATION (pH)

ACID—(SOUR)			CIRCUM—(NEUTRAL)			ALKALINE—(SWEET)		
3.1—4.0	4.1—5.0	5.1—6.0	6.1—6.9	7.0	7.1—7.9	8.0—8.9	9.0—9.9	10.0—10.9
Super Acid	Medi Acid	Sub Acid	Minim Acid	Neutral	Minim Alkaline	Sub Alkaline	Medi Alkaline	Super Alkaline

SOIL REACTION SCALE

A soil showing a ph value of 6-8, the circum-neutral zone, furnishes the best physical conditions for most plants. In acid bog soil organic acids have accumulated, causing ph values as low as 4 and 5. In alkaline acid or semi-acid soils sodium carbonate may accumulate changing the soil to a reaction as high as 9 and 10 ph.

5. SOIL LIFE

A very ancient form, never absent in a fertile soil, but visible only with the microscope, is known now as belonging to the class of micro-organisms, called bacteria. Some bacteria are definitely responsible for the fertility of the soil, serving as middle men in the nutritive chain. Jordan found in one gram of soil:

25 fixing nitrogen of the atmosphere, forming nodules on roots, wherein nitrogen substances are transformed.

7500 nitrifying, building up nitrogen compounds.

50,000 denitrifying, breaking down such compounds.

50,000 urea bacteria, decomposing the urea of manures and fertilizers in ammonia and carbon dioxide.

1,750,000 peptone decomposing bacteria, breaking down proteins to ammonia and other compounds.

Ammonia and its compounds are evidently not themselves assimilated by plants to any extent. They are first oxidized due to the action of nitrite forming bacteria as nitrosomonas into nitrite which then is transformed into nitrate by the nitro-bacter bacteria. These nitrifying organisms develop upon inorganic substances and appear to utilize the atmospheric carbondioxide for their supply of carbon. These nitrates and nitrites may be reduced again to ammonia, to oxides of nitrogen and free nitrogen, by the denitrifying bacteria of the soil, if conditions are favorable such as presence of nitrates, readily decomposable organic material, suitable temperatures and want of tillage.

However, soil life is not restricted to multitudes of bacteria. Soil workers connected with the Rothamsted Experiment Station have counted also the numbers of animalcules, protozoa, lowest forms of microscopic animals, as amœbæ, flagellates and ciliates. Their data represents the average numbers obtained in the high activity period of the spring and the low activity period of the winter.

SOIL-POPULATION

	Number per gram of soil	*Approx. weight lbs. per acre*
Bacteria—High Activity	45,000,000	50
Low Activity	22,500,000	25
Amœbæ—High Activity	280,000	320
Low Activity	150,000	170
Flagellates—High Activity	770,000	190
Low Activity	350,000	85
Ciliates—High Activity	1,000	—
Low Activity	100	—

MOLDS

In soil as well we find the fungi or molds, the comrades of roots and fallen leaves and stems assisting decay of highly organized compounds, helping conduction of the mineral food, destroying here, building there, active, even replacing roots and rootlets in their development as "mycorrhiza," which we find in an increasing number of cases benefiting plant growth.

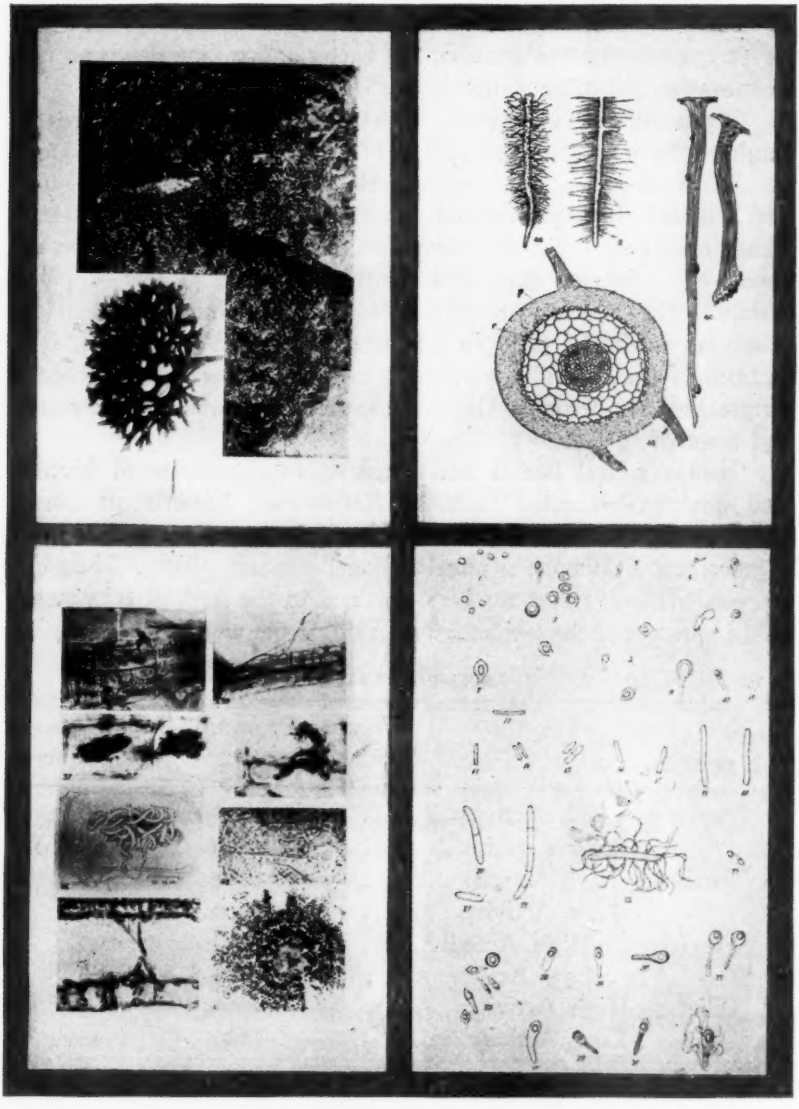


Fig. 4. Soil Population.

a. Irish Moss Growing on Massachusetts Rock. (After Tressler.)

b. Root-hair- and Mantle-like Fungi (Mycorrhiza)., Growing on Root of Beech (3), and South African Pine (4). (After Frank.)

c. Penetration of Mycorrhiza Into Plant Cells of Hosts, Where They Are Digested and Agar Cultures. (After Rayner.)

d. Soil Bacteria (Urea Bacillus), by Viehoever.

LICHENS Molds grown in close companionship with algæ life form a very ancient group living a slow and often starving existence. We find them almost everywhere, in the frigid zone as well as in the tropics, on rocks, on soils, on barks, and stumps, in the dark moist surface of the forest floor as in sunlighted spots of the open spaces. Lichens are indeed resistent organisms, adapted to certain restricted moisture and nutritional conditions. They, too, assist in their way in the breaking down and building of soil and plant food elements.

ALGAE These forms, profiting as we have seen, under certain conditions of want from their association with molds, live also as individuals. The green and blue-green algæ belong indeed to the simplest living plants. They live in water or in wet places, and are considered to have been associated with the earliest fossils. Similar animal life, occurring in the soil and water, evidently still depends upon such algæ. These use their green and blue-green pigments to build up their carbon compounds from the carbon dioxide of the atmosphere with the help of sun energy. They enrich in these and other ways the organic as well as inorganic food materials.

ANIMALS Besides the lowest forms, the protozoa, we find worms, garden snails, and various stages of insect life, other useful agents in the soil. They stir, aerate it, keep it mixed and often fertilize it with their manure and worn out bodies.

These organisms mentioned convert the organic matter in the soil, the plant remains and manures into useful plant foods. They produce nitrates, valuable soil colloids from plant and animal materials and non-toxic end products from intermediate substances.

SOIL DISINFECTION While all these forms of life in soil are noted for their share for good, an excess or the presence of unwanted types may upset all the happy balance of soil for sod and do an untold harm, causing disease, destruction and decay of plants and crops. Tired soils are those yielding, after years of fertility, very poor crops—unless purified, that is partially sterilized. This partial sterilization is effected with heat (steam) at temperatures of 80 to 100 C., or with chloroform, carbon disulphide, toluene or ether. It is believed that this soil disinfection not only removes excessive and unwanted micro life, but that certain toxic substances accumulated in the soil may be destroyed and that wax-

like remains of micro life, enclosing the humus particles, will be dissolved by this treatment.

The humus will then again be available for renewed growth of micro-organisms. Whatever the detailed causes, it is an evident fact that partial disinfection restores the balanced micro life and fertility of the soil.

6. SOIL FERTILITY

The secret of fertility hidden in the soil, the clothing blanket of the earth, has engaged the attention of many earnest workers from primitive man to the ablest of living scientists. One clue after another has been disclosed so that we can today quite definitely mention the following as essential factors involved in the fertility of the soil.

1. Soil constitution; the presence of certain soil elements, chemical plant food elements and the organic humus.
2. Soil texture; the adequate preparation.
3. Soil tillage; the appropriate condition.
4. Soil reaction: the acceptable concentration of hydrogenions.
5. Soil life, the suitable micro population and activity.
6. Soil moisture, the necessary supply.
7. Soil climate, the desired temperature ranges.
8. Plant: the right kind for particular soils.

Of the eighty and more chemical elements known the following have been quantitatively isolated.

TABLE I

Elements in the Earth Crust *

	%		%
Oxygen	46.46	Chlorine	.05
Silicon	27.61	Bromine	....
Aluminum	8.07	*Phosphorus*	.12
Iron	5.06	*Sulphur*	.06
Calcium	3.64	Barium	.04
Magnesium	2.07	*Manganese*	.09
Sodium	2.75	Strontium	.02
Potassium	2.58	Nitrogen	....
Hydrogen	.14	Fluorine	.03
Titanium	.62	All other elements	.50
Carbon	.09		

* Determined by F. W. Clark.

However, not all of these serve as plant food. In fact, only about 15 per cent. of an average good soil can ever become plant food, according to Professor Truog, of the Department of Soils of University of Wisconsin. The remainder of the soil material is important, however, as it makes up the framework of the soil, gives it favorable physical structure and pore space. It provides stability for the plant, necessary aeration for the entrance, movement and exchange of water and gases—essential for the growth of roots.

TABLE II

Elements in Living Protoplasm *

Oxygen	72.0%	Hydrogen	9.1%
Carbon	13.5%	Nitrogen	2.5%
Sulphur, Phosphorus, Chlorine, Sodium, Potassium, Calcium, Magnesium, Iron, Silicon, Fluorine, Iodine, Manganese, traces		together less than	3%

These elements, with the possible exception of sodium, are accepted as essential plant food elements. Boron must be added as essential to plant life—and copper for certain soil as the Florida peat soils. Copper sulphate added at the rate of forty to fifty pounds per ton of fertilizer has produced in some sections striking increases in crop returns.

Many of the essential elements are needed in such small quantities by the plants that due to their abundance in either soil or atmosphere they hardly need ever to be replaced.

AIR DERIVED ELEMENTS

The supply of oxygen and carbon, primarily present in the air as carbon dioxide, is practically inexhaustible, though increase in the amount of carbon dioxide over that usually present in nature (soil or air) benefits plant life. Nitrogen, abundantly available in the atmosphere, may be secured directly by certain microscopic organisms, commonly found in soils, and in part associated with the roots of leguminous plants, as beans, clover, alfalfa. Plowing under of these crops enriches the soil with nitrogen for non-legumes.

*C. Wood.

SOIL DERIVED ELEMENTS

The amount of aluminum and iron, according to soil surveys of Iowa and other regions, remain practically constant. Potassium, while generally present in normal soils, is usually lacking in peats and swampy soils. It must be added to soils, upon which tobacco is grown. Calcium, so necessary in the formation of the plant skeleton and so desirable often in the correction of soil reaction, is rarely altogether lacking. Soil bearing crops of legumes, clover and alfalfa in particular, require more lime than others. Magnesium, considered unnecessary until recently, is now recognized as an essential. Sulphur, evidently absent in many soils, appears of value in the growing of certain crops though its function in soil fertility is not fully understood. Carbon liberated in the soil as carbon dioxide is an essential ingredient of fertile soil. Carbon is the basal element of all organic substances, furnishing the building stones of cell wall and cell contents: protoplasm, sugars, starch and proteins.

AVAILABILITY

The plant food elements however are only available to plants in the dissolved condition. Consequently plants will suffer for lack of food, unless the food elements are soluble or the micro-organisms, the agents of soil life, change the unavailable insoluble material into the usable, soluble form. As a result plant food is removed from the soil by both crops and by leaching. That the amount of food elements found in various farm crops is considerable is evident from data given in Table III.

TABLE III

Plant Food in Crops and Value—Jefferson County Soils

Crop	Yield	Plant, Food, Lbs. Nitrogen	Phosphorus	Potassium	Value of Plant Foods Nitrogen	Phosphorus	Potassium	Total Value of Plant Food
Corn, grain	75 bu.	75	12.75	14	$12.00	$1.52	$0.84	$14.37
Corn, stover	2.25 T.	36	4.5	39	5.76	0.54	2.34	8.64
Corn, crop	....	111	17.25	53	17.76	2.07	3.18	23.01
Wheat, grain	30 bu.	42.6	7.2	7.8	6.81	0.86	0.46	8.13
Wheat, straw	1.5 T.	15	2.4	27	2.40	0.28	1.62	4.30
Wheat, crop	....	57.6	9.6	34.8	9.21	1.14	2.08	12.43
Oats, grain	50 bu.	33	5.5	8	5.28	0.66	0.48	6.42
Oats, straw	1.25 T.	15.5	2.5	26	2.48	0.30	1.56	8.28

Crop	Yield	Plant Food, Lbs. Nitrogen	Phosphorus	Potassium	Value of Plant Foods Nitrogen	Phosphorus	Potassium	Total Value of Plant Food
Oats, crop	....	48.5	8	34	7.76	0.96	2.04	14.70
Barley, grain	30 bu.	23	5	5.5	3.68	0.60	0.33	4.61
Barley, straw	0.75 T.	9.5	1	13	1.52	0.12	0.78	2.42
Barley, crop	....	32.5	6	18.5	5.20	0.72	1.11	7.03
Rye, grain	30 bu.	29.4	6	7.8	4.70	0.72	0.46	5.88
Rye, straw	1.5 T.	12	3	21	1.92	0.36	1.26	3.54
Rye, crop	....	41.4	9	28.8	6.62	1.08	1.72	9.42
Potatoes	300 bu.	63	12.7	90	10.08	1.25	5.40	17.00
Alfalfa, hay	6 T.	300	27	144	48.00	3.24	8.64	59.88
Timothy, hay	3 T.	72	9	67.5	11.52	1.08	3.95	16.55
Clover, hay	3 T.	120	15	90	19.20	1.80	5.40	16.40

Calculating Nitrogen (N) at 16 cents (Sodium Nitrate ($NaNO_3$)); Phosphorus (P) at 12 cents, Acid Phosphate, and Potassium (K) at 6 cents (Potassium Chloride (KCl)).

The loss of fertility depends upon the type of farming, live stock, dairy or grain farming. Where no manure is produced and the whole grain crop is sold—as in grain farming, the soil very quickly becomes depleted in essential plant foods. Constant cropping alters the soil chemically and biologically. Experience has shown that soils may be kept permanently fertile by controlling the moisture in the soil, by crop rotation, by replacing the deficient mineral and organic plant foods, through manuring and fertilizing.

An oversupply of fertilizer, especially chemicals which are readily soluble, will give such a heavy concentration to the soil water that it becomes more dense and more concentrated than the sap within the individual cells of the roots. The result is the reverse of the usual procedure, inasmuch as the sap diffuses out of the cells, and they thus lose their water content. This causes them, in turn, to take the water from the rest of the plant, causing wilting.

MOISTURE

The soil moisture is one of the most important factors governing crop production. In too dry soils plants suffer for lack of water, containing the food, as well as of available plant food; the production of available plant food ceases, as bacterial life and activity becomes restricted. In too wet soils plants suffer, through leaching out of plant food or for lack of air

and available food, since decay is checked, beneficial bacterial action is limited and unavailable organic matter accumulated.

Cultivation, drainage or irrigation are the most important farm operations keeping the soil in the best condition for crop production. The moisture may be conserved in the soil by frequent hoeing and the maintaining of a good mulch. The nature of the surface soil and especially of the sub-soil determine largely the need for drainage. With heavy tight clay as a sub-soil a surface layer of clay loam will be much affected by excessive rains; a sandy surface will be prevented from rapid drying out and ready losses through leaching. Especially effective in the absorption and retention of moisture and plant food elements, thus preventing ready leaching, is the presence of humus in the soil.

Commercial Fertilizers

Besides the well-known manures; horse, cow, sheep, poultry, bird and bat fresh, dried or shredded, powdered, we find in commerce chemical and organic fertilizers containing two or three of the essential plant foods, the nitrogen, phosphorus and potassium fertilizers.

	Nitrogen Fertilizers or Carriers			
	Nitrogen (N)	Ammonia (NH_3)	Phosphoric Acid (P_2O_5)	Potash (K_2O)
Sodium Nitrate natural or manufactured (Chilisaltpeter)	15–16%			
Ammon. Sulph. nitrate (Leuna saltpeter) manufactured	26%	31.5%		
Calcium nitrate (28% Lime) manufactured	15.5%	18.8%		
Ammon. sulphate	20%	25%		
Ammon. phosphate or other preparations	20%		20% Avail.	
Calcium cyananide	15%			
Urea	46%	55%		
Dried blood meal		11–17%		
Meat meal		12–14%	1–5.9%	
Animal tankage	4–9%	7–12%	3–12%	
Fish meal		8–12%	4–8%	
Castor pomace		5–8%	1–5%	1–5%
Cottonseed meal		7–9%	2.5–3.5%	
Activated sludge		5–7.5%	7–20%	0.5–1%
Bone tankage or other proportion	4–12%		2–5%	
Garbage tankage		3–4%		

Phosphorus Fertilizers

	Nitrogen (N)	Ammonia (NH_3)	Phosphoric Acid (P_2O_5)	Potash (K_2O)
Phosphate rock (66–75% or 75–80% Calcium phosphate)			20–28% mainly unavailable	
Acid phosphate (available calcium phosphate) and calcium sulfate (Gypsum)			14–19% available 0.5–2% insoluble	
Super phosphate (double or treble)			40–50% available 0.5–4% insoluble	
Basic slag (Thomas slag)			11–25% much available or 16–19% much available or over 12% (80% soluble) 2% citric acid	
Bone meal (50–55% calcium phosphate)			22–28%	2–3%
Nitrophoska (balanced fertilizer)	15%		30%	15%

Potassium Fertilizers

	Nitrogen (N)	Ammonia (NH_3)	Phosphoric Acid (P_2O_5)	Potash (K_2O)
Kainit (Nat. deposit with potassium muriate)				12.4–16%
Potassium muriate				50–50.5%
Potassium sulphate				40–50%
Tobacco stem		2–4%		4.9%
Hardwood ashes (unleached)				2–8%

Lime Fertilizers

Calcium carbonate with 56% lime (CaO); 44% carbon dioxide.
Lime stone, marble, oyster shells.
Marl (natural deposit) often containing 75 to 95% calcium carbonate.
Calcium oxide—Lime, burnt lime with 80–95% lime (CaO); 1–5% carbon dioxide. Quick lime.
Calcium oxide (hydrated) with 60–80%; 20–30% water.
Hydrated lime.
Calcium sulphate (hydrated); (gypsum).

Lime (calcium) is often considered only as an indirect fertilizer though it functions in the structural upbuilding of the tissue. It neutralizes harmful soil acids, aids nitrification, reduces crust formation of loam soil; as limestone it enriches the soil in carbon dioxide.

To increase its usefulness and that of other plant foods, manufacturers of fertilizers combine it with forms of nitrogen as nitrates or urea, or with phosphorus.

CARBON AS FERTILIZER

The gasing with carbon dioxide as the only available form of carbon has been carried out with marked results of increased growth in commercial greenhouses. The amount normally obtained in the process of assimilation was thus increased to assist the metabolism. The increase of carbon dioxide in the soil hastens the solution of otherwise insoluble soil minerals as phosphates and potassium salts. It thus opens the soil, making it granular and loose, permitting aeration and transformation of harmful iron salts.

Carbon dioxide serves as an effective buffer, aiding in the prevention of excessive acidity and alkalinity. It is liberated not only from carbonates and urea but also from green manure, crop residues, farm manure, other organic fertilizers and decomposable organic substances as leaf mold or available humus.

Dried commercial humus contains about 60 per cent. carbon and 3 to 4 per cent. nitrogen, transformed under favorable soil and balanced food conditions by soil life into available carbon and nitrogen compounds.

Humus is also one of the most important soil colloids, that is, substances which increase absorption of plant nutrients, water holding capacity and surface area of soil-forming constituents.

LAW OF MINIMUMS—PRINCIPLES OF RATIOS

In spite of the beneficial effect of early added plant food to the general soil fertility, the law of minimums, suggested already by J. Liebig, prevails. As every nutrient as well as growth factors (heat, light, water, air) have a distinct and specific effect and as the missing factor cannot be replaced by any other, growth consequently is limited by the substance or factor least available.

Certain relations between food elements have been quite definitely established and designated as nitrogen-carbon ratio and nitrogen carbohydrate ratio; thus the accumulation of nitrate in the soil is determined largely by the abundance of organic material (carbon)

present. The ratio of carbon to nitrogen averages about *1:10* in our soils.

Too heavy application of nitrogen fertilizers, disturbing the nitrogen carbohydrate ratio, result in excessive vegetative growth of crops at the expense of the root system, while the opposite effect results in nitrogen deficiency.

II

Magic Carpet

1. JUNGLED JUNGLE

The tropical jungle is pictured to us as a forest of wilderness of towering as well as fallen tree trunks (filled with parasites), supporting countless creepers —climbing and crawling in all directions, halting the foot of man at every step—jungle, an impenetrable tangle of trees, bushes, vines and briars, a veritable hell, in which man without axe and hatchet is hopelessly lost.

Favorable temperature and high humidity and an abundant micro life in both atmosphere and soil, all contribute to the rapid and irresistible growth. The soil through this rapid decay of organic growth is greatly enriched in important essentials, especially in organic compounds and humus. Carbon dioxide, available in increased amounts to the breathing pores of plants, both from the air as well as soil, likely is an important factor contributing to the splendid horror, confronting or surrounding man, lost in the jungle.

2. WELCOME WOODS

Similar conditions may prevail in our virgin forests, though growth there is less wild or rapid. The primitive redwoods, the pines of Maine and other forested regions display their majesty more freely to man. The needles of pines, hemlock and spruce make the soil face sour, causing reaction, unfavorable to many other plants. Fresh oak leaves also sour the soil and we, in consequence, do find these oaks and other acid loving plants as heath predominate, yes, exclusively exist in acid soils.

The leaves of other trees as beach and maple cause no marked change in soil reaction, the ph values found were six to eight, a range preferred by the majority of plants.

Most woodland soil is acid, few woodland trees caring for much lime; juniper, yew, arbor vitæ, common cypress, maple, beech, buckeye, ash and elm prefer an almost neutral soil.

Some plants, few mosses and mushrooms grow on limestone cliffs, where during certain stages the soil reaction may be expected to be somewhat alkaline. Some others of these forms prefer an acid soil; thus certain mosses may be used as indicators for acid soil—though these indications may require checking as the same types do good on soil in want of nitrogen.

All woodland plants are accustomed to rich nourishment supplied largely by the heavy leaf mold, constantly forming on an already good loam; this leaf mold may become so deep that many plant roots never reach far into the sub-soil below.

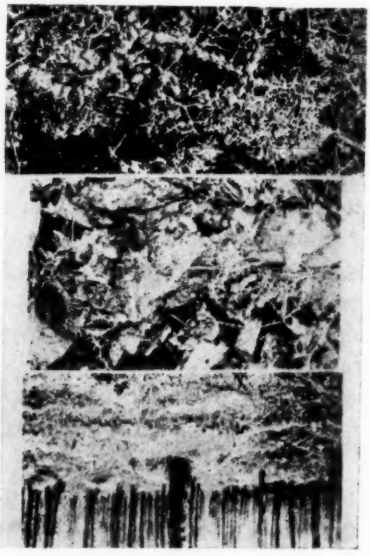


Fig. 5. Earth's Garment.
Leaf Mold and Lichens on Surface of (from "Mycorrhiza") Forest Soil.

Trees as the hemlock and maple with their spreading surface roots keep the grounds about them very dry; those that strike deep with but one tap root draw their main supply from the sub-soil and leave a fair amount on the surface. A spreading root system drains the soil most heavily underneath the outer branches. Plants will best grow close to the trunk or beyond the branch radius. In the case of tap rooted trees, draining the soil underneath the trunk, plants thrive better outside the tree area.

Most woodland plants prefer moist places, protected from prolonged exposure to direct sunlight and wind. If we would enjoy a

Average Botanical Composition of Pasture Vegetation as Influenced by Fertilizers, Lime and Manure

Bradford County—Volusia Soil—1918-1927.

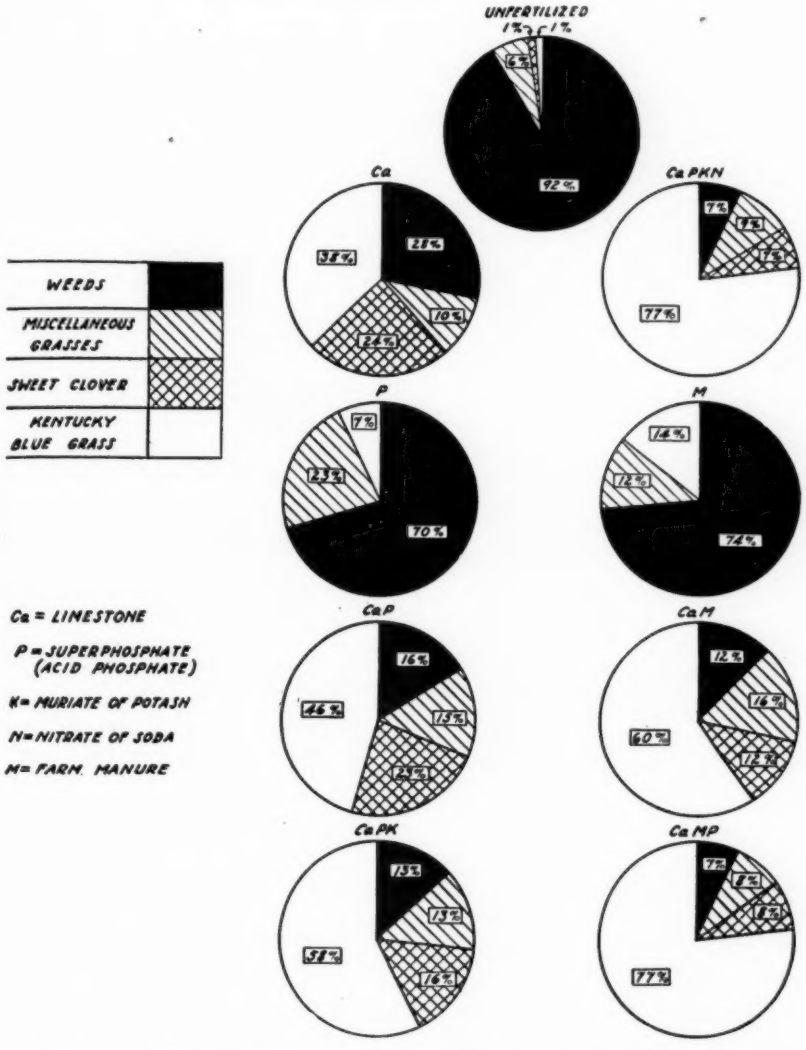


Fig. 6. In the Production of a Permanent Kentucky Blue Grass Pasture on Westmoreland Soil, Lime Shows Clearly Its Value in Paving the Way for the Profitable Use of Commercial Fertilizers and Manure. Both the Complete Fertilizers and Manure Plots Reinforced With Superphosphate Have Produced a Pasture Practically Free From Weeds, Containing From 95 to 96 Per Cent. of Pasture Grasses.

touch, a feeling of woods in our gardens we must furnish such conditions to the trees, the ferns, the woodland lilies, solomon seals, trilliums, foxgloves, lady slippers and the vines.

3. PLEASANT PASTURES

While in undrained areas as swamps and peat bogs we usually find a stunted and restricted growth (as either sphagnum moss, sedge, or saw grass or certain other seeds and grasses) in meadows, where conditions greatly favor growth, we find a wealth of plant varieties.

The types of plants taking food and holding on depends of course much on the nature of the soil and the environment. The vigor of growth, as aforesaid, depends upon the presence, concentration, choice of needed elements, and then still further on the soil reaction and soil life. The influence of judicious use of fertilizers, lime, manure, tested over a ten-year period and illustrated here, is striking and remarkable.

The grasses giving our best pastures and yielding our best forage crops generally also give good turfs. They are discussed under turf grasses.

4. FERTILE FIELDS—CROPS

The selection of the crop or crops suited to the soil is even more important in the case of fields, planted and cultured. Much available progress has been accomplished on the relation between crop and soil, on best suited texture and most effective fertilizers. Indeed one worker, Davidson, has shown that nitrogen in certain forms applied at a later stage of growth increased the protein content in grain.

The need of plants for definite plant foods may be readily demonstrated by growing them in mineral free distilled water and in nutrient solutions with and without certain essential elements. Lack of potassium affects leaf growth and leaf strength; lack of phosphor affects leaf growth, especially seed forms; lack of iron interferes with the development of the green plant pigment. The stimulating effect of carbon dioxide or plant growth has been variously demonstrated. Stocklasa obtained an increase in weight from 52.6 g., the weight of the ungassed plant, to 142.4 g. the weight of the plant gassed with carbon dioxide. That certain substances as aluminum may interfere with root growth has been demonstrated with barley, that sublimate even in smallest quantities is toxic, has been demonstrated with geranium plants.

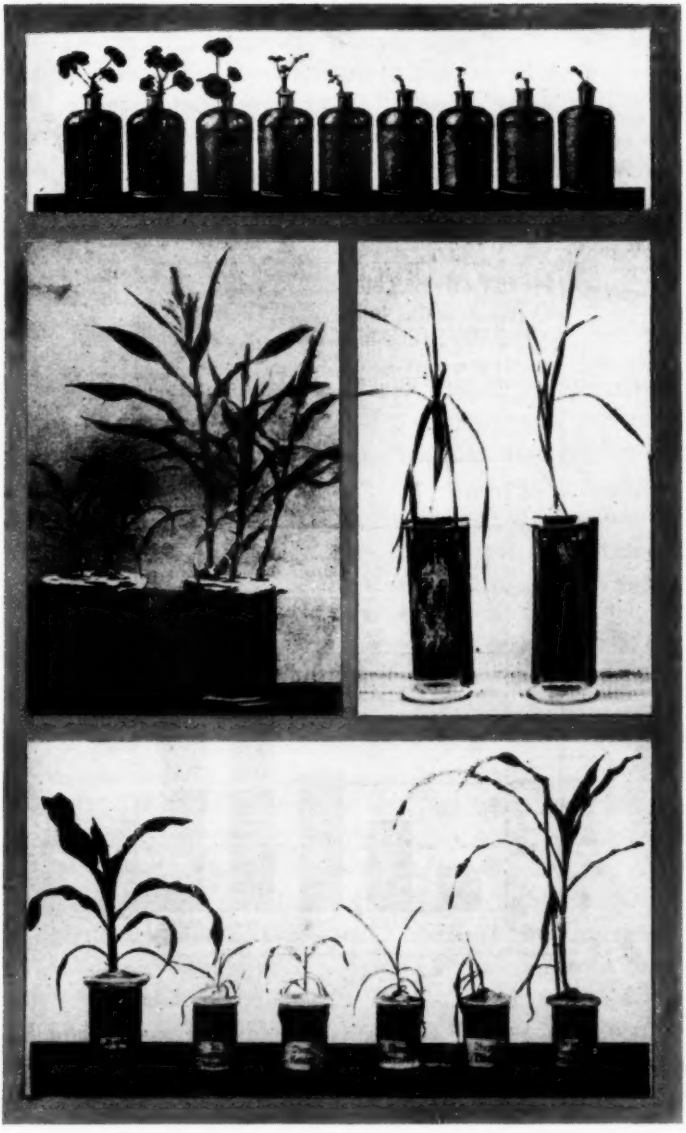


Fig. 7. Elements of Nutrition and Poisoning.

a. Maize, Showing Effect of Chemicals on Growth. Left to Right. Mineral Nutrient Solution, Distilled Water, Without Potassium, Without Phosphorus, Without Iron, Check on No. 1. (After Zander.)

b. Corn, Small Plant With Normal Carbon Dioxide. Large Plant With Excess Carbon Dioxide. (After Stocklasa.)

c. Barley, Left, Without Aluminum. Right, With Aluminum.

d. Geranium; Mineral Nutrient to Which the Following Quantities of Bichloride of Mercury Have Been Added. Left to Right, .00005 Per Cent.; .0001 Per Cent.; .0005 Per Cent.; .001 Per Cent.; .003 Per Cent.; .005 Per Cent.; .007 Per Cent.; .009 Per Cent. (After Zander.)

Soils consisting to 50 per cent. more of sand generally are regarded as "light," and as especially adapted to the raising of early vegetables. Soils containing more clay and less sand constitute the "medium" or "heavy" classes. They have been found best suited either to corn, potatoes, tobacco, cotton, and fruit—or to grass and other dairy-farming crops.

Even though soils may be similar in mechanical composition,

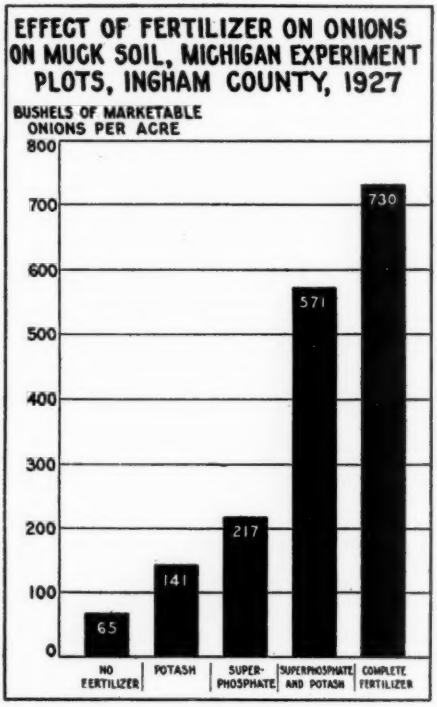


Fig. 8.

certain factors as climate or drainage may alter their adaptability to the same crops. Cotton, for instance, is restricted to the climate of the Southern States; it may be grown there readily on various types of soil except those of very deep sand or very hard clay.

When well drained and rolled, the muck and neutral fertilized peat soils are excellent soils for celery, cabbage, onions, sugar beets, all kinds of truck crops as potatoes, for hemp—peppermint, spearmint and grasses. Professor Harmer's interesting results are given below.

Onion Yield on Fertilized Peat Soils

Fertilizer applied broadcast 1922-23-24-25-26-27, and pounds per acre	Marketable onions bush. per acre	av. wt. per onion ounces	% of immature onions	% of bulbs sprouted May 15
No fertilizer	65	12	82	36.4
Muriate of potash, 500 pounds	141	1.7	72	15.2
Superphosphate, 750 pounds	217	1.5	32	51.0
Phosphate, 750 pounds; potash 500 pounds	571	2.6	12	11.5
Nitrogen, 300 pounds; superphosphate, 750 pounds, and potash, 500 pounds (balanced fertilizer)	730	3.3	7	13.4

Most of our vegetables, beets, cabbages, squash, tomato and pumpkin, lettuce, and celery—the bean, wheat, rye, and corn grow satisfactorily on circumneutral soil—while the potato evidently prefers subacid soils.

These data check well with the lime requirements as determined by the soil workers of the Wisconsin Agricultural Experiment Station. Sugar beets, cabbage, lettuce, onion, spinach have a very high lime need, peas, cauliflower, barley a high—peanuts, corn, potato, turnip, carrot, radish and grape a medium, sweet potato a low lime need.

DRUG PLANTS

Digitalis purpurea (fox glove) and the plant yielding one of the most important drugs, a heart stimulant, as well as Sarothamnus scoparius (broom bush), do evidently not thrive well on calcareous or alkaline soil (see Ill.). Digitalis grew and fruited under the most favorable circumstances in soil containing 6 per cent. lime, though plants showed weakened condition. Grown on clay and lime soil the plants died after two months. In soil with 32 per cent. lime the plants grew only to four-fifths of an inch.

Tobacco, according to soil workers of the Wisconsin Experiment Station, requires a very high lime content, hops, rape, mulberry require a high, rhubarb and hemp a medium, flax a very low amount of lime for satisfactory growth.

In his studies of soil reactions preferred by the "snake roots" obtained from the drug plant Polygala Senega (a cough relief) and related species, Wherry found variation from minim-alkaline dry soil (ph 7.1-7.9) to mediacid wet soil (ph 4.1-5.0) and all intermediate degrees. Polygala Senega tested in Virginia and Pennsylvania, the variety latifolia in Arkansas, the species alba, known as false senega,

tested in Texas and Oklahoma, all preferred minim acid dry soil (ph 6.1-6.9).

Experiments with coltsfoot, grown under varied conditions in soil and nutrient solution, proved the marked influence of hydrogenion concentration and source of nitrogen, affecting this concentration, upon growth (see Fig. 9).

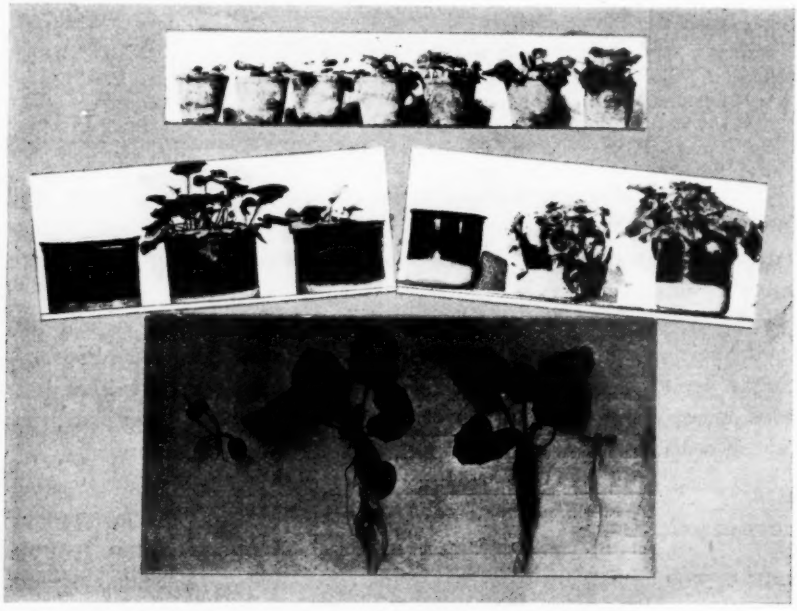


Fig. 9. Coltsfoot. (Tussilago Farfara.)
a. Influence of Soil Reaction. Ph. 3.6; 4.7; 5.2; 5.4; 6.7; 7.6; 7.7.
b. Nitrogen Availability. NH_4Cl NH_4NO_3 NaNO, After 1½ Months.
c. Nitrogen Availability. NH_4Cl NH_4NO_3 NaNO, After 3½ Months.
d. In Nutrient Solution. 3.5; 4.5; 5.5; 6.5; 7.5; 8.0. (After Olsen.)

Drug and Poisonous Plants*

Plants Apparently Preferring Mediacid Soils
(ph 4.1-5.0)

Arnica	Arnica.
Coptis trifolia	Goldthread.
Cypripedium acaule	Pink Ladyslipper.
Drosera	Sundew.
Epigaea repens	Trailing-arbutus.

*Selected from Dr. Wherry's findings.

Ilex opaca ..... American holly.
Kalmia polifolia ..... Bog Kalmia.
Ledum groenlandicum ..... True Labrador-tea.
Magnolia glauca ..... Sweetbay.
Sorbus americana ..... American Mountain-ash.

Plants Apparently Preferring Subacid Soils
(ph 5.1-6.0)

Acer spicatum ..... Mountain Maple.
Aletris farinosa ..... Star grass.
Anaphalis margaritacea ..... Pearl Everlasting.
Arachis hypogaea ..... Peanut.
Athyrium filixfemina (angustum) ..... Upland Lady Fern.
Baptisia tinctoria ..... Yellow Wild-indigo.
Betula lenta ..... Sweet Birch.
Castanea dentata ..... American Chestnut.
Castanea pumila ..... Chinquapin.
Ceanothus americanus ..... Jersey-tea.
Chamaecyparis, named species and varieties ..... Cypress.
Chamaelirium luteum ..... Fairywand.
Chinonanthus virginica ..... White Fringetree.
Cimicifuga americana ..... American Bugbane.
Clematis crispa ..... Curly Clematis.
Comptonia asplenifolia ..... Sweetfern.
Convallaria majalis ..... Lily-of-the-valley.
Cunila mariana ..... Stonemint.
Cystisus scoparius ..... Scotch Broom.
Daphne, named species (D. odora and D. Mezerum) minimalkaline ..... Daphne.
Dryopteris dilatata (americana) ..... Mountain Woodfern.
Eryngium aquaticum ..... Button-snakeroot.
Gaultheria procumbens ..... Wintergreen.
Gelsemium sempervirens ..... Carolina-jessamine.
Heuchera villosa ..... Hairy Alumroot.
Ilex cassine ..... Dahoon.
Ilex opaca ..... American Holly.
Iris carolina ..... Southern Blueflag Iris.
Juniperus communis montana ..... Mountain Juniper.
Kalmia angustifolia ..... Lambkill.
Kalmia latifolia ..... Mountain Laurel.
Lycopodium clavatum ..... Runningpine.
Magnolia (accuminata, tripetala, excepting M. glauca) ..... Magnolia.
Menyanthes trifoliata ..... Common Bogbean.
Mitchella repens ..... Partridgeberry.
Myrica ..... Bayberry.

Nicotina species (also listed under circumneutral) . Tobacco.
Oxalis acetosella (montana) ..... Common Woodsorrel.
Phlox ovata ..... Mountain Phlox.
Pinus, many though not all species ..... Pine.
Polygala paucifolia ..... Fringed Polygala.
Rhododendron ..... Rhododendron.
Rubus idaeus ..... European Raspberry.
Solanum tuberosum ..... Potato.
Spiraea tomentosa ..... Hardhack.
Ulex europaeus ..... Common Gorse.
Viola pedata ..... Birdsfoot Violet.
Zygadenus ..... Poison lily.

Plants Apparently Preferring Minimacid Soils (ph 6.1-7.0)

Aesculus pavia ..... Red Buckeye.
Amelanchier ..... Shadblow.
Apocynum androsaemifolium ..... Spreading Dogbane.
Avena sativa ..... Oats.
Cardamine pratensis ..... Cuckooflower.
Citrullus vulgaris ..... Watermelon.
Corylys rostrata ..... Beaked Hazelnut.
Epilobium angustifolium ..... Blooming Sally.
Garcinia mangostana ..... Mangosteen.
Gillenia trifoliata ..... Bowmansroot.
Hicoria ovata ..... Shagbark hickory.
Juniperus communis and var. ..... Common juniper.
Juniperus Sabina and var. ..... Savin juniper.
Juniperus Virginiana ..... Red Cedar.
Linum usitatissimum ..... Flax.
Liquidambar styraciflua ..... Sweetgum tree.
Liriodendron tulipifera ..... Tulip tree.
Lupinus hirsutus ..... European Blue Lupine.
Monarda didyma ..... Oswego Beebalm.
Ostrya Virginiana ..... Am. Hophornbeam.
Phaseolus lunatus ..... Lima Bean.
Quercus velutina ..... Black Oak.
Rubus occidentalis ..... Common Blackcap.
Sassafras variifolium ..... Sassafras.
Sophora japonica ..... Japanese pagoda tree.

Plants Apparently Preferring Circumneutral Soils (ph 6.1-7.9)

Acacia ..... Acacia.
Aconitum ..... Monkshood.
Adiantum ..... Maidenhair Fern.

Aesculus	Buckeye.
Ailanthus, named species	Ailanthus.
Allium porum	Leek.
Alnus	Alder.
Althea species	Hollyhock.
Apium graveolens	Celery.
Asparagus	Asparagus.
Aquilegia, many species	Columbine.
Aralia, many species	Aralia.
Artemisia	Wormwood.
Aster, many species	Aster.
Berberis	Barberry.
Beta, vulgaris varieties	Beet.
Calendula officinalis	Calendula.
Catalpa species	Catalpa.
Celastrus	Bittersweet.
Centaurea species	Centaurea.
Cephalanthus occidentalis	Buttonwood.
Cercis	Redbud.
Clematis	Clematis.
Crocus	Crocus.
Cydonia	Flowering quince.
Delphinium, many species	Larkspur.
Dianthus	Carnation, Pink.
Digitalis	Foxglove.
Dirca palustris	Leatherwood.
Erythronium	Trout Lily.
Eucalyptus species	Eucalyptus.
Gardenia species	Cape Jasmine.
Gentiana	Gentian.
Geranium	Cranesbill.
Gymnocladus dioica	Kentucky Coffee Tree.
Hamamelis Virginiana	Witch-hazel.
Hedera	Ivy.
Helianthus	Sunflower.
Hordeum vulgare	Barley.
Hypericum	St. Johnswort.
Impatiens	Impatiens.
Ipomea	Morning glory.
Juglans	Walnut.
Lactuca sativa	Garden Lettuce.
Ligustrum	Privet.
Lonicera	Honeysuckle.
Lobelia, many species	Lobelia.
Lycium, many species	Matrimony vine.
Mentha, many species	Mint.
Narcissus	Narcissus.

Oenothera	Evening primrose.
Origanum species	Majorum.
Oxalis	Oxalis.
Paeonia	Peony.
Panax Quinquifolium	American ginseng.
Passiflora	Passion flower.
Phylittis scolopendrium	Hartstongue.
Polyganatum species	Solomon's seal.
Populus	Poplar.
Potentilla, many species	Cinquefoil.
Piper	Pepper.
Quercus alba	White oak.
Radicula armoria	Horse radish.
Raphanus sativas	Radishes.
Reseda	Mignonette.
Ribes	Currant, Gooseberry.
Robinia, named species	Locust.
Rosa	Rose.
Salix	Coneflower.
Sanguinaria canadensis	Bloodroot.
Scilla species	Squills.
Secale cereale	Rye.
Sempervivum, many species	Houseleek.
Sheperdia argentia	Silver buffaloberry.
Solanum dulcimara	Bitter nightshade.
Solanum, many species	Nightshade.
Solidago, many species	Goldenrod.
Sorbus aucuparia	European Mountain ash.
Spiraea (many species)	Spirea.
Syringa	Lilac.
Tamarix, named species	Tamarix.
Taraxicum officinale	Dandelion.
Taxus	Yew.
Tulipa	Tulip.
Tussilaga farfara	Coltsfoot.
Vinca, named species and varieties	Creeping myrtle.
Viola (many species)	Violet, pansy.
Xanthoxyllum americanum	Prickly ash.

5. TOUGH TURFS Turfs are the foundation of golf links, parks and home grounds. They must be resistant to wear and abuse, and special attention must therefore be given to the preparation, grading, cultivation and enriching of the soil, to the selection of good seed or grass-stolons, and to continued care. A deep loamy soil, already possessing a good texture, needs but to be enriched with plant food elements. A stiff clay soil to produce a good turf must be mixed

with both sand and vegetable matter. Clay will improve light sandy soils. "Decayed vegetable matter, or humus," state the U. S. soil experts, "lightens the texture of clay soils, increases their water holding capacity, and improves their drainage; it also improves sandy soils by making them more cohesive and more retentive of moisture." The top soil, carefully leveled, should be made loose and fine for a depth of 2 to 3 inches.

Drainage, if necessary with tiles, must be provided, as it is recognized that "perfect turf cannot exist without perfect drainage." Neither can good turf be maintained in our climate without an artificial supply of water. Enough water should be used to wet the ground down at least 4 to 6 inches at a time to reach the deeper grass roots. Continuous watering, however, washes the plant food from the soil and starves the turf.

Bone meal, best applied in late winter or very early spring at the rate of 10 pounds to 1000 square feet, is referred to as one of the best commercial fertilizers by U. S. soil experts. They also recommend the application, three times a year, of a mixture of one part of ammonium sulphate and three parts of organic plant food as cotton seed meal, applied at the rate of 12 to 15 pounds per 1000 square feet. Annual whitewashing of turfs with lime is now known to be both wasteful and detrimental as it encourages greatly the growth of certain weeds and clover. It is believed that 50 pounds hydrated lime (lawn lime) applied to 1000 square feet once in six to eight years will be sufficient for any soil type.

The best insurance against weeds is the dense stand and vigorous growth of the cultivated grasses, which will give crabgrass and other weeds, as dandelion, plaintain, chickweed, veronica and oxeye daisy little opportunity to grow. The top dressings must be free of weed seed. The soil reaction is preferably kept acid (to prevent weeds as chickweed) unless white clover, requiring a limed soil, is grown. This, mixed in grass mixture, is used for an even and especially for a sloping lawn.

While ammonium sulphate alone will eliminate weeds from the acid resistant bent and fescue grasses, a mixture with acid phosphate and potassium muriate in amounts of 250 pounds each per acre will furnish a more complete plant food. This is recommended by soil workers of the Rhode Island State College. The weeds will be gradually crowded out, especially if the acid reaction of the soil is maintained by annual or more frequent application.

Turf Grasses

1. *Kentucky Blue Grass*—Poa pretensis

A native of the Old World, it is now a favorite grass for fairways and lawns, in the North, and is also the principal pasture grass on all rich soils. It is a perennial, creeping underground, having very narrow, vivid, deep, green leaf blades. It grows abundantly on all good soils, whether rich in lime or poor.

2. *Sheep's Fescue*—Festuca ovina

This is an excellent grass for fairways and lawns to grow on poor, sandy or gravelly land and a valuable element of pastures on such soils. It is mixed with other grasses to make a durable sward. A bunch grass with dense tufts and wirelike, bluish gray leaves.

3. *Red Top*—Agrostis alba or palustris

As a vigorous grower, forming a coarse, loose turf, it is considered valuable for fairways and lawns if mixed with other grasses as blue grass. It is a perennial grass with creeping growth and narrow leafblades. It is strongly drought resistant, protects banks against erosion—grows on soil very poor in lime, but will not last more than a year or two under lawn conditions.

4. (Shady Lawn Grasses)—Red Fescue—Festuca rubra (Chewing Fescue)

This is much used grass for golf courses, where the soil is sandy, and for steady lawns, as it will withstand more shade than most grasses. It has bright green leaves and creeps by underground stems.

5. *Birdgrass*—Poa trivialis

"The queen of the pasture grasses" is far superior to any other grass on shady lawns. It is best adapted to cool moist soils. It spreads by stolons or creeping branches on the surface of the ground. The leaves are apple green, remain bright green in winter weather. The turf makes an exquisite lawn.

6. *Southern Turf Grasses.* Bermuda grass—Cynodon dactylon

This is the most important plant for pastures and lawns in the South, particularly on clays and loams though it grows more or less abundantly on sandy soils. It occurs in varied forms with pale green to rich blue green foliage and is commonly planted by stolons.

7. *Italian Rye Grass*—Lolium italicum

The seed sown on Bermuda grass, turning brown in the fall, makes a bright green winter sward and excellent fairway for winter. It is treated as an annual, produces a turf very quickly and is used as a temporary pasture.

8. *Putting Green Grasses*—Creeping Bent—Agrostis Stolonifera.

It is in great demand for golf courses, as it is considered one of the finest grasses for putting greens, producing a beautiful fine turf. It has creeping stolons or runners, which grow as much as 4 feet long in a season. There are many strains, bluish to green, and coarse to very fine. The grass grows well, especially in seaside meadows and on light moist soil.

9. *Rhode Island Bent*—Agrostis tenuis

It yields a beautiful grass, making a fine turf, also used for putting greens. The seed forms usually a large proportion of the highly esteemed South German mixed bent. It has narrow flat leafblades, forming dark green turf and succeeds well on well-drained soils, including acid soils—liming in fact injuring the turf.

6. BUSH AND BLOOM

Broad-leaved Evergreens.—One of the most decorative blooming bushes, grown more and more frequently in our parks and gardens—is the Rhododendron. Our domestic production of these plants, recently stated a representative of one of the largest nursery dealers, only dates back to about 1915. It has been carried on principally by men who acquired their training in Holland where the natural soil conditions are such as to produce an abundance of growth. No artificial means of fertilizing are necessary there, or any other preparation, with the exception of attention to such details as planting at the proper time, and clean culture. Mainly through the lack of scientific knowledge of fundamental soil requirements there have been many losses and disappointments in our attempt to produce these plants on a large scale.

It is now definitely known that mycorrhiza (fungi) live in close association with the roots, and most of these favor acid reaction of the soil. Where the soil is normally acid, the addition of leafmold, cow manure, acid peat or peat moss and good fibrous loam have given good results, provided no lime was present to neutralize the acid in the soil. Cuttings have been rooted in sandy acid peat or peatmoss litter with

sand, young plants transplanted with good balls of soil around roots have been grown successfully in limefree loam or sandy peat, enriched with humus or well-decayed vegetable matter, rotting wood, half-rotten oak leaves, spent tan barks, rotted sawdust from non-resinous woods. Aluminum sulphate applied in amounts of about 1 pound to 18 square feet of ordinary garden soil has been found to produce satisfactory acidity and growth.

For continued growth the adoption of soil conditions where rhododendron grows wild has been found desirable. The soil there is acid and of loamy nature, rich in mineral plant food, well drained, though retentive of moisture. The acid top layer is full of partly decayed organic matter, in which the shallow-rooted plants feed. Addition of organic matter to the soil at the time of planting and successive mulching retain the water, needed even in winter, and prevent deep freezing.

Other broad-leaved evergreens as azaleas and mountain laurel (kalmia latifolia) thrive under similar conditions of acid soil. The same is true of trailing arbutus, heath, heather, huckleberry, bearberry, cranberry, wintergreen and andromeda.

Of interest in this connection is that certain strains or related species of these acid soil loving bushes, may be found thriving on lime soil. Such is the case with certain Chinese species of rhododendron, found on lime cliffs and grown for seven years in limed soil.

Hydrangeas (the Red, White and Blue).—Of other interesting and highly ornamental plants the hydrangeas are highly favored. They thrive in any good, well-drained, but somewhat moist garden soil, preferring a rich porous soil mixture. Three principal types are grown, the somewhat tender shiny leaf hydrangea also called garden or Japanese hydrangea; the shrubby and the climbing hydrangea. While these latter have predominantly white colored flowers, the flowers of the shiny leaf hydrangeas occur in varied colors, dependent evidently on the soil reaction. Lime in some excess produces pink flowers, in great excess a yellowing and a stunting of growth. Acid conditions, use of alum, rusty iron, iron filings, cause a blue coloring. The treatment, according to the U. S. Horticulturist, E. L. Mulford, must be started one year before the result is desired. In young potted plants this blueing of flowers may be obtained upon watering with an alum solution (one tablespoon to a gallon). In a bush several tinned iron can covers planted two inches from the plant and four inches deep in the soil produced a remarkably deep blue hue.

While the magnolias generally prefer subacid soil, our common decorative bushes: forsytnia, hawthorn, lilac, deutzia, the butterfly bush, rosemallow, mockorange and the spireas; our hedges: common box, barberry and privets; our climbers: ivy, grapevines, honeysuckle, clematis, euonymus, convolvulus, wisteria, all do well on circumneutral soil. Wisteria requires a special dose of potash, water, wants sun, except the South Atlantic variety growing and blooming in the shade.

Fruit Blooms, Bulbs and Cut Flowers

Pear, cherry, plum and apple, currant and gooseberry, almond and peach grow satisfactorily on circumneutral soil; so do the bulbs of spring: the hyacinth, tulip, and narcissus; the bulbs of summer: gladiolus, peony and dahlia, while woodland lilies prefer subacid soil. All bulbs are said to like a cool, moist, well-drained soil, shade for the bulbs and lower part of stems, plenty of light and air above.

Phlox species want subacid soils, some iris species as the Japanese and Oregon iris the same—other flags and most delphinium species prefer a circumneutral soil. So do sweet peas, grown best in black, heavy, fertile soil with lots of water.

Recent researches (reported at the New York Meeting of the Association for the Advancement of Science) show that flowering plants grown under controlled conditions in silt lawn soil of medium organic content in a greenhouse, yielded the following suggestive results:

Snapdragons gave the most flowers in an acid soil (ph of 6.0 to 6.5); in an alkaline soil, the best stems (ph of 7.0 and 7.5).

Calendula gave the best flower and stem in an alkaline soil (ph 8.0). The root development was very poor in very acid plots. Carnations developed most flowers in an acid soil of (ph 6.5). Chrysanthemums gave largest flowers and best stems in slightly acid soil. Cyclamen preferred acid soil (ph 5.0 to 6.0). Primula malacoides was very sensitive to acid soil, dying in a soil of ph 5.0 within two weeks. Primula obconica, geraniums, callas and cinerarias showed a preference for alkaline soil. The only flowering plant evidently growing well in all ranges of soil reaction was coleus.

Orchids, as far as known and grown in soil, prefer the acid reaction. The cultivation, difficult though it is, has greatly increased, on account of the exquisite beauty and remarkable keeping qualities of the flowers. Cut flowers of some orchid species have remained

perfect for more than three weeks, flowers left on the plants have kept perfect for more than three months.

The greatest obstacle in the growing is the germination of the seed, which, lacking food for its own germination, requires the presence and nursing help of certain specific forms of microlife, fungi, or the nourishment with a specially balanced, sterile nutrient agar.

ROSES—Sappho, so many years ago already, concluded:

"The rose, mankind will all agree,
The rose the queen of flowers shall be;
Its fragrance charms the gods above,
Its beauty is the food of love."

We can scarcely conceive of a garden void of roses. The rose included somewhere in the friendly lawn, framing the home, greatly enriches its ornamental value. However, the ground is often poorly prepared or unsuited. Either the soil lacks certain valuable ingredients or is rose fatigued, through prolonged growing of roses. Even the neglect of providing a mound of soil around the pruned branches of newly planted roses, handicaps the rose from the start. Destructive soil life, as worms and bugs in greenhouse soil, may be kept down by partial sterilization of the soil, or by cut potatoes placed near the base to attract the worms.

Roses in general prefer a cool, loose, fairly heavy, fertile, circumneutral loam soil containing sufficient humus, lime as well as some magnesium.

Lawn soil prepared to 20 and 25 inches depth with an application of one-half pound of chalk to the square yard of rose bed area, well supplied with humus and complete fertilizer and in early spring with an ounce of magnesium sulphate to the same area is said to have given continued good results.

Washington, the heart of the Nation, is also the show place for bush and bloom, for lawn and park, and experimental growth. Great gardens as the DuPont gardens and greenhouses near Wilmington, or the famed Magnolia, Azalea and Middleton gardens of Charleston, South Carolina, the rose gardens of Portland, Oregon, and Pasadena, California, enriched by the blend of natural beauty and human skill in selection and care, are rapidly becoming national institutions. In many other communities we find now magnificent gardens, parks and reservations.

There is a growing public demand for state or nationally owned and surveyed parks, creek, lake, river shores and forests. Thus much destruction by the element of nature or by man of soil or sod is prevented. Natural wonders are preserved or re-created as lasting contributions to American life.

Results and Outlook

1. Though skill has grown, though many a long-hidden secret is now disclosed, no certain mastery of soil and sod as yet has been achieved.
2. When sand or clay, or stone predominate, the proper blend of soil ingredients does not prevail—humus is needed too.

Fig. 10. Man's Control of Nature's Carpet.
U. S. Agricultural Department Grounds, Washington, D. C.

3. The spirit of the soil is dead, whenever microlife is made to die through lack of water, air and worthy elements of food.
4. Fair climate, fertile soil and well-adapted crops should make the growing possible, though parasites of molds and bugs play frequent havoc yet with root or fruit with leaf or stem.
5. The proper care of soil as well as sod, an all-important task, will help to grow God's plants this year and next and untold years to come.
6. Men must assume control, though here and there in ignorance of what to do; quick action, wisely used, will often save his starving grounds at home, the soil and suffering crops afield, restore, assure the fertile beauty of a magic force.

Thus with man's help we see how life prevails victorious over death—from barren waste of rocks over the sterile sand of deserts—through the green hill of the jungle to the heavenly fertile fields and man's throne, the home, midst verdant carpets and the splendor of gorgeous blooms.

"With eager eye and earnest face
The Man of science long pursues
The quest—succeeding, then renews
His zealous search with quickened pace."

(*C. A. Ruckwick*)

CORRESPONDENCE

THE UNITED STATES PHARMACOPŒIAL CONVENTION

Eleventh Decennial Convention for the Revision of the Pharmacopœia of the United States of America

1820-1930

REID HUNT, M. D.
240 Longwood Avenue,
Boston, Mass.

Boston, Mass., January 25, 1930.

To the Editors of Medical and Pharmaceutical Journals:

Some months ago I mailed you an abstract of the Constitution and By-Laws of the Pharmacopœial Convention, setting forth the date of the next Decennial Convention and the list of organizations eligible for representation in the Convention.

In further compliance with the provisions of the By-Laws another "Call" is enclosed and you are earnestly requested to again announce in your journal the date for the Convention, namely, May 13, 1930, and to urge eligible organizations and colleges which have not yet done so to send for credential blanks to the Secretary of the Convention, Lyman F. Kebler, M. D., 1322 Park Road, N. W., Washington, D. C.

The Board of Trustees have asked that credentials be filed with the Secretary of the Convention by March 14, 1930.

Respectfully,

REID HUNT, M. D.,
President of the United States Pharmacopœial Convention of 1930.

CALL FOR THE

Eleventh Convention for the Revision of the Pharmacopœia of the United States of America

United States Pharmacopœial Convention
(Incorporated 1900)

Boston, Mass., January 25. 1930.

In compliance with the provisions of the Constitution and By-Laws of the United States Phamacopœial Convention, the President of the Convention hereby invites the several bodies, entitled under the Constitution to representation therein, to appoint delegates to the Eleventh Decennial Convention to meet in Washington, D. C., on May 13, 1930, and the attention of all concerned is invited to the following extract from the Constitution and By-Laws:

Chapter I, ARTICLE VIII, of the By-Laws of the United States Pharmacopœial Convention provides that the President of the Convention:

> "shall issue on or about the first of May of the year immediately preceding that of the decennial meeting, a notice inviting the several bodies, entitled under the Constitution to representation therein, to send delegates to the next meeting. He shall repeat the notification eight months later, and shall request the medical and pharmaceutical journals of the United States to publish the call for the said meeting."

ARTICLE II, Section 1, of the Constitution provides:

> "The members of the United States Pharmacopœial Convention, in addition to the Incorporators and their associates, shall be delegates elected by the following organizations in the manner they shall respectively provide: Incorporated Medical Colleges, and Medical Schools connected with Incorporated Colleges and Universities; Incorporated Colleges of Pharmacy, and Pharmaceutical Schools connected with Incorporated Universities; Incorporated State Medical Associations; Incorporated State Pharmaceutical Associations; the American Medical Association, the American Pharmaceutical Association, The American Chemical Society, the National Association of Retail Druggists, and the National Association of Boards of Pharmacy; *provided that no*

such organization shall be entitled to representation unless it shall have been incorporated within and shall have been in continuous operation in the United States for at least five years before the time fixed for the decennial meeting of this corporation."

SECTION 2 of the Constitution provides:

"Delegates appointed by the Surgeon-General of the United States Army, the Surgeon-General of the United States Navy, and the Surgeon-General of the United States Public Health Service, the Secretary of Agriculture, the Secretary of Commerce, the Association of Official Agricultural Chemists, the Association of American Dairy, Food and Drug Officials, the National Wholesale Druggists' Association, the National Dental Association, the American Drug Manufacturers' Association, the United States Division of Customs, and the University of Havana, and by the organizations not hereinbefore named which were admitted to representation in the Convention of 1900, shall also be members of the corporation. Each body and each branch of the United States Government above mentioned shall be entitled to send three delegates to the meetings of this corporation. But no such delegates as are provided for in this article shall be members until their credentials shall have been examined and acted upon as provided for by the By-Laws. Delegates admitted as members at any decennial meeting shall continue to be members of the United States Pharmacopœial Convention until their successors shall have been appointed and admitted as delegates to the ensuing Convention and no longer."

REID HUNT, M. D.,
President of the United States Pharmacopœial Convention of 1930.

LYMAN F. KEBLER, M. D.,
Secretary of the United States Pharmacopœial Convention of 1930.
1322 Park Road, N. W., Washington, D. C.

MEDICAL AND PHARMACEUTICAL NOTES

ADRENAL GLAND EXTRACT AND CANCER—The accidental discovery of two San Francisco doctors that adrenal cortex extract causes disintegration of dangerous and hopeless cancers may prove to be an important addition to weapons of medical science.

So important is this new development in the fight on cancer that the University of California's medical departments and the Hooper Foundation are mobilizing to aid Dr. Walter Bernard Coffey, chief surgeon of the Southern Pacific Hospital, and his assistant, Dr. John D. Humber, in further researches on the promising preparation.

An extract made from the endocrine gland, the adrenal cortex, of sheep was being used by Drs. Coffey and Humber to produce lowered blood pressure, and they noted that it had a disintegrating action upon a tumor in the same subject. In their preliminary report to the San Francisco Pathologic Society they told how they then used the gland extract in the treatment of three hopeless cases of human cancer, one of them cancer of the tonsil. Graduated doses of the extract were injected under the skin and necrosis was caused to such an extent that the tumors sloughed and the patients were better temporarily.

The new extract is not yet ready for wide use and much more research must be done to discover its applications and limitations. The method of preparation of the extract has not yet been announced by Drs. Coffey and Humber and its composition is not yet known. The adrenals are small organs just above the kidneys.

The work of Dr. Coffey and Dr. Humber is, in effect, a continuation of the line of research reported by Dr. Boris Sokoloff, of the Institute of Cancer Research, Columbia University, New York, who at the International Physiological Congress at Boston last fall told of the destructive effect upon cancer of an extract of the adrenal cortex mixed with an iron salt and pyrrol blue.—*(Science Service.)*

LIGHT IN THE TREATMENT OF DISEASE*—Many newspapers, in commenting on the recent radio broadcast of the United States Public Health Service pertaining to the use of light in the treatment

*United States Public Health Service.

of disease, unfortunately misquoted the service as condemning the use of lamps emitting ultra violet rays. It is felt that this misstatement of facts is most unfortunate, for such lamps have unquestionably been shown to be of great value when used under certain conditions.

It is known that light may have a beneficial effect in certain diseases. Some diseases respond to light treatment more readily than others. The response also depends upon the severity of the disease, the state of immunity, and personal idiosyncrasies. Light has been used with benefit in certain forms of anemia; in the treatment of diseases due to faulty assimilation; in the deficiency diseases due to lack of vitamins; in tuberculosis of bone, joints and glands; for the cure of local conditions such as wounds and ulcers; and for the relief of deep-seated congestion, neuritis and certain skin diseases. Light is of value in the cure and prevention of rickets; it promotes growth; and it is of value in restoring tone and function during convalescence from severe infection.

Since the amount of natural light from the sun, and especially its ultra violet ray content, varies with the geographical location, the season of the year, and such local conditions as the amount of dust, smoke and moisture in the atmosphere, under some conditions, reliance may be placed on sources of artificial radiation. These sources are generally called lamps, or radiators.

There are different types of lamps used for the production of artificial light for therapeutic purposes; first, those that emit heat, light and ultra violet rays in approximately the same proportion as sunlight; second, those in which ultra violet rays predominate; and third, those that emit light and heat, but little ultra violet light.

The lamps of the first type have white hot filaments, or electrodes, which radiate light and heat, and have also incandescent mercury vapor, or a carbon arc, which radiates ultra violet rays. In these lamps the incandescent mercury vapor, or the carbon arc, is shielded from the person using it by a globe, or plate, of a special kind of glass which cuts off the very short ultra violet rays which might be harmful. These lamps are so designed that the ultra violet, light and heat radiations emitted by them are combined, as nearly as possible, in the same proportions as in natural sunlight. Since the radiation from them is very similar to sunlight, they may, to a certain extent, be used in place of, or as a substitute for, sunlight. If these lamps are to be used in the treatment of any disease or over long continued

periods of exposure, one should have the advice of a competent physician. At all times caution must be observed in exposing one's self to any lamp. When using these lamps it may be necessary to use goggles to protect the eyes.

The second type of lamp, such as the unscreened mercury vapor, or the unscreened carbon arc lamp, besides light, heat and antirachitic ultra violet rays emits a large amount of ultra violet rays of very short wave length. Such lamps should only be used upon the advice and under the direction of a physician. The large amount of antirachitic ultra violet light emitted by them makes them very useful when operated by the physician, but dangerous when used by the layman without the advice of a physician. For the same reason such lamps should never be used without goggles to protect the eyes. Excessive or improper use of ultra violet rays may cause serious injury to the eyes, injury to the skin, serious symptoms in persons with low blood pressure, and unfavorable effects in persons with early tuberculosis. Exposure to ultra violet radiation may cause restlessness and, in overdoses, anemia. Severe burns are also sometimes experienced.

The third type of lamp is similar to the ordinary incandescent lamp used in electric lighting. It emits both light and heat. The very small amount of ultra violet light emitted by it is of long wave length and is negligible in quantity. The rays of light and heat from these lamps heat the skin and the superficial tissues. They have been found to be useful in the treatment of rheumatism and similar troubles. The only danger from them is that of a burn such as would be experienced by exposing the skin in front of a hot fire.

It will be evident from this discussion of the different types of lamps in use that a lamp that would be useful for one purpose would not be useful for another, and indeed might have a harmful effect. It is evident that a person without medical training should not select and use a lamp at random, but before purchasing and using a lamp should consult his physician.

ELECTRIC ANTISEPTIC—Antiseptic solution made to order at the turn of a switch is now a possibility. A new machine takes common salt and ordinary lighting current and automatically produces a powerful antiseptic in just the right concentration. The antiseptic, known to physicians as Dakin's solution, and to chemists as sodium hypochlorite, is formed in a specially designed miniature electrolytic cell

which was developed in the chemical engineering laboratories at Iowa State College.

Carbon electrodes were adopted for use in this cell after trying out electrodes of platinum, tantalum, nichrome and carbon. The upper electrode, or cathode, is hollow and slips over the lower electrode, or anode, from which it is insulated by an insulating cement. The electrodes are contained in a cylindrical glass bulb, the bottom of which is drawn out to a small tube. The salt solution enters at the bottom and as it flows between the electrodes it is decomposed, forming sodium hypochlorite solution. This passes out through a glass tube on the side of the cell. The rate of flow is regulated by a glass stopcock.

The current is supplied from the alternating current light line through a battery charger and is regulated by a rheostat. The flow of the solution through the cell is controlled by an automatic valve which remains open while the current is flowing. After the current and solution flow have been regulated, sodium hypochlorite of the proper concentration and alkalinity is produced at the turn of the switch.

The whole apparatus except the salt container and battery charger can be placed in a box six by twelve by seven inches, which is large enough for a physician's office. A portable set operating from the storage battery of a car, or a larger set for hospital use can be made.

Dakin's solution, which this apparatus produces, was selected from over two hundred antiseptics as the best antiseptic and irrigating agent for war wounds. Its use has been limited because of its poor keeping qualities and the technical skill necessary for its preparation in proper concentration. The new apparatus is simple in construction and provides freshly prepared solution as wanted at low cost.—*(Science Service.)*

ZINC SULPHATE A WEED KILLER—Zinc sulphate, sometimes called white vitriol, will kill weeds in a plant bed full of conifer seedlings but will not harm the little trees, Professor Ferdinand H. Steinmetz and Professor Fay Hyland, of the University of Maine, have found. They reported their discoveries recently to the American Society of Plant Physiologists at its sixth annual meeting.

Eight grams of zinc sulphate, dissolved in sufficient water and sprinkled over a square foot of ground, is most effective, it was

learned. Germination of the seeds and growth of the little trees was only slightly reduced by the dose, while practically all the weeds were killed.—*(Science Service.)*

EGGS AND DRUGS—"No known drug or combination of drugs when fed to poultry will increase egg production," says Dr. H. E. Moskey, veterinarian in the Food, Drug and Insecticide Administration of the United States Department of Agriculture.

"The department," he says, "has objected repeatedly, by warning and seizure, to the use of any label on drug preparations for fowls which indicates the preparations will increase egg production. Veterinarians agree that such claims are unwarranted and consequently fraudulent. The department will not relax its efforts to keep from the channels of interstate trade all products for which such exaggerated promises are made to poultrymen."

Other preparations equally objectionable, Dr. Moskey says, are those sold to increase the fertility of eggs and to improve their hatchability. This is not within the power of drugs.

Drug preparations offered as a cure for poultry diseases for which there is no known drug cure are also receiving the attention of officials. These diseases include typhoid, cholera, coccidiosis, fowl pest, roup, diphtheria, chicken pox, diarrhea and gapes of chicks, and blackhead of turkeys. Some of these can be prevented by proper precautionary methods but once contracted do not respond to drug treatment.

Doctor Moskey explains, also, that a worm remedy for fowls must be labeled clearly; the specific name of the worm or worms for which it has been proved an effective vermifuge must be stated. Veterinarians, he says, have found that certain drugs are effective for certain worms but no combination of drugs is effective against all worms. Furthermore, drugs administered by way of mouth have not been found effective against those known as pin or cæca worms of poultry. Products of this type when labeled to be given by mouth are subject to seizure under the law.

The labeling of mineral mixtures, stock powders, so-called conditioners and regulators, and tonics, to indicate that they remedy or control worm infestation, constitutes misbranding under the Federal Food and Drugs Act, Doctor Moskey says. Preparations of this character have not proved effective in this manner. Neither must

the labels on tonics, minerals, or other products indicate that they will increase disease resistance of fowls or ward off disease.

NATURE'S METHOD OF PURIFYING POLLUTED WATER—In the study of the pollution of streams the United States Public Health Service has directed considerable attention to the operation of natural processes in the purification of polluted water, especially the agencies and methods utilized by nature in this process. In this intensive study it has been found that pollution (sewage, non-poisonous industrial wastes, and similar polluting matter) when put into water, is immediately attacked by bacteria which are so small that at least two millions of them could rest comfortably, side by side, on the head of a common pin. These minute organisms find the pollutional material a satisfactory food and increase rapidly in numbers. By this feeding process, oxygen dissolved in the water is used up and the pollution is transformed into harmless bacterial bodies and by-products which are not putrescible.

At first it was believed that the bacteria, unassisted, could completely purify polluted water. This was found not to be the case, however. The bacteria multiply in the polluted water until a certain number of population is reached, the limiting number varying with the amount of pollution present. When the limiting population is reached, multiplication stops and the process of purification also stops, although considerable amounts of pollution may still be present. If the bacterial population of the water is reduced at this time, the multiplication and purification processes continue. To arrange for a continuous reduction of bacterial numbers, nature, in her marvelous economic system, has provided some very small animals, called protozoa, whose principal food appears to be bacteria. These bacteria eaters, which are very much larger than bacteria, but yet so small that fifty of average size could lie on the head of a common pin, feed continuously on the bacteria and thereby prevent the bacterial population from ever reaching a limiting number.

In this manner nature provides for the completion of the purification process, and the bacteria and the protozoa in the water decrease in numbers as the amount of food available for each decreases.

The addition of any poisonous substance to the polluted water may slow up or, if a sufficient amount be added, completely stop nature's purification process, by killing off prematurely these industrious workmen.

A series of interesting papers describing the methods employed and the results obtained in these studies are being published in the public health reports under the general heading of "Experimental Studies of Natural Purification in Polluted Waters."

REPORT ON MEDICINAL TABLETS AND AMPULES ISSUED BY UNITED STATES DEPARTMENT OF AGRICULTURE—Suggested tolerances on medicinal tablets and ampules, with methods of analysis, have been put in printed form by the United States Department of Agriculture at the instance of manufacturing associations.

The sixth and seventh reports of the committee representing the American Drug Manufacturers' Association and the American Pharmaceutical Manufacturers' Association, contains these proposed tolerances, for the information and consideration of the Department of Agriculture and the drug trade.

The medicinal tablets involved are: Caffeine citrate, bismuth subcarbonate, bismuth subgallate, bismuth subnitrate, and mercuric iodide; the ampules are of: Caffeine sodium benzoate, camphor in oil, pituitary extract surgical, silver nitrate, sodium cacodylate, sodium iodide, and sodium salicylate. Amendments to previous reports on calomel tablets and calomel and soda tablets are given in the report.

Copies of the report may be obtained from the Food, Drug and Insecticide Administration, United States Department of Agriculture, Washington, D. C.

NEWS ITEMS AND PERSONAL NOTES

NEW FILMS ON ACIDOPHILUS ARE AVAILABLE—Two interesting moving pictures have been prepared on Mulford Acidophilus Bacillus Blocks.

One illustrates the place of acidophilus in preventive medicine and includes some very unusual animated drawings showing the action of acidophilus in the intestines.

The other reel tells how M. A. B. are made, illustrating the very ingenious manufacturing process and giving some idea of the care that large laboratories must maintain in safeguarding their products for the physician and his patients.

These films are now available and are recommended for inclusion in the programs of your society meetings.

Write the H. K. Mulford Company, Broad and Wallace Streets, Philadelphia, and arrangements will be made to supply these films as near to the date you suggest as possible.

College Celebrates Pasteur Day—The memory of Louis Pasteur was honored at the Philadelphia College of Pharmacy and Science at a special assembly on January 8th.

The principal feature of the assembly was the presentation to the Philadelphia College of an original oil painting, a gift of Dr.

Louis Pasteur

William Duffield Robinson, distinguished Philadelphia physician and a member of the Board of Trustees of the Philadelphia College.

The address of the day was delivered by Dr. Joseph McFarland, Professor of Pathology of the University of Pennsylvania, who spoke on the life of Pasteur.

It is especially appropriate that the memory of Louis Pasteur should be honored by this old college of pharmacy, because Pasteur made his first important discoveries while teaching at the college of pharmacy at Strassbourg, Alsace, and because some of Pasteur's early papers were published in the *American Journal of Pharmacy*.